



Hospital Emergency Department Management
of Mass Casualty Incidents Involving
Biological and Chemical Terrorism

by

Lee A. Knapp, RN, CEN
Wade M. Knapp, CPS

Protective Research Group

The following text has been designed for educational purposes only and should not be considered a definitive work on the subject of medical management of emergencies stemming from biological and chemical terrorism.

Copyright ©2000 Lee A. Knapp and Wade M. Knapp, All Rights Reserved

Table of Contents

Introduction	5
Exploring the Impact of a Biological or Chemical Weapon Attack	6
Fundamental Concepts of Terrorism	9
Terrorism Classifications	10
Tactics and Weapons of Terrorism	12
The Structure of a Terrorist Group	14
Potential Targets of Terrorism	15
Terrorist Target Selection	16
Terrorist Intelligence Gathering Operations	18
Planning the Terror Attack	19
BioCrime and ChemiCrime	19
Characteristics of Biological Weapon Agents	21
Anthrax	25
Plague	27
Tularemia	29
Cholera	30
Escherichia Coli	32
Q Fever - Rickettsial Type	33
Smallpox	35
Venezuelan Equine Encephalitis	37
Viral Hemorrhagic Fevers	39
Botulism	41
Ricin	43
Staphylococcal Enterotoxin B	44
Trichothecene Mycotoxins	45
Characteristics of Chemical Weapon Agents	47
Nerve Agents	49
Vesicants	53
Pulmonary Agents	57
Blood Agents	59
Riot Control Agents	61
Other Chemical Agents	63
Mass Casualty Incident Planning	70
Emergency Department Planning	71
Integration of Support Departments	72
Communications	77
Integrating Local Emergency Medical Services (EMS)	79
Decontamination Procedures	80
Decontamination Structures	80
Designation and Zoning of Receiving Area	81

Patient Decontamination	83
Decontamination Process	85
Personal Decontamination	86
Equipment and Facility Decontamination	86
Triage Operations	87
Simple Triage & Rapid Treatment (START)	87
Personal Protection Equipment	91
Respiratory Equipment	91
Protective Clothing	94
Emergency Department Equipment	96
The Buddy System	96
Proper Donning of PPE	96
Proper Doffing of PPE	98
Determining Equipment Needs	99
Critical Incident Stress	100
News Media Relations	103
Information Resources	105
References	108
About the Authors	109

Introduction

The threat of a terrorism incident involving the use of biological or chemical weapons has become an issue of great concern in the United States. Information regarding this possible threat is being released to the American public at an alarming rate. Analysis being released by U.S. Government Agencies, U.S. Military, Research Organizations, and a host of other professionals indicates that the threat of a terrorist act utilizing one of these Weapons of Mass Destruction is both real and credible. This analysis often states that it's not a question of "if" such an attack will occur, but "when and where" such an attack will occur.

Biological and Chemical Weapons of Mass Destruction are designed to injure or kill large numbers of people at one time. Originally designed for use as a combat weapon in the theater of war, their use was eventually considered inhuman and discontinued. This was assured by the United Nations Biological and Chemical Conventions which banned the use of these weapons. However, not all nations have agreed with or signed the Convention documents. It is suspected that several rouge nations, and numerous international and domestic terrorist groups, may possess these weapons, possess the equipment and components necessary to manufacture these weapons, or possess the desire to obtain or develop these weapons. The foundation of this threat we face stems from the minds of these nations, groups, and individuals who wish to possess and use Weapons of Mass Destruction against an unprotected civilian population. Understanding this reality, the next question to ask ourselves is "what can we do to reduce the likelihood of this type of incident occurring here in the United States?". The answer to which is both simple and complex.

The first step in reducing the possibility of terrorist incidents involving the use of Biological or Chemical weapon agents is to improve the basic awareness of this type of terrorism. Without an adequate understanding of the fundamental aspects of these Biological and Chemical weapons, their characteristics and effects, response protocols, medical treatments, etc., we remain at the mercy of the incident itself. A clear understanding of the problem allows for the creation of clear solutions to the problem, resulting in an effective response. The greatest emphasis regarding education of this type of terrorism should be afforded to our local emergency response community, especially hospitals. Biological and Chemical agents used as weapons have the potential of creating unbelievable numbers of medical casualties. Injured victims will have to be transported to hospitals in order to receive proper medical treatment. Hospitals and their Emergency Departments must be prepared and equipped to receive and treat the victims of such a terrorist incident. By in large, U.S. hospitals are still unprepared to respond to terrorism incidents of this type. The medical community themselves must realize this and begin to take steps to effectively manage medical disasters resulting from the use of Biological and Chemical Weapons. Law Enforcement, Fire Departments, EMS / Rescue, Security Personnel, etc. should also receive extensive training and physical resources which will allow them to prepare and respond more effectively to these types of incidents. The key to effective management of this type of terrorism will reside in our ability to train and equip our emergency response personnel with the means for early detection and quick response to such an incident. In addition, more educational resources regarding biological and chemical terrorism should be directed toward the general public which will be the intended target.

This book has been developed with the goal of creating a clearer understanding of the realities associated with the medical management of Biological and Chemical Terrorism. It has been designed for use by a variety of medical professionals such as Nurses, Physicians, Administrators, Paramedics, Pharmacists, etc. The book is also applicable to emergency response planning for a variety of medical provider locations such as Physician's offices, Outpatient care facilities, Assisted Living facilities, Pharmacies, etc.

Exploring the Impact Of A Biological Or Chemical Weapon Attack

Outside of a few professional groups and the United States Military, there is a very poor understanding of biological and chemical weapons and their effects. Few civilian law enforcement agencies, emergency responders, or community hospitals are prepared for, or even understand, the devastating effects that can occur within a community if one of these weapons is released. This reality creates an enormous risk to public safety, not to mention the risk confronting the emergency response community. While it is true that a large scale incident involving the use of a biological or chemical weapon has not occurred in the United States, we should not use that fact as a reason not to prepare. The sheer nature of terrorism dictates that we will probably never know in advance when or where an incident may occur. We should not presume that advance warning of a terrorist attack will be given. In addition, we probably will not know the type of biological or chemical agent used until after the attack has occurred. Because the time and place of the attack, and the weapon to be used is under the control of the terrorist, he or she will usually have the advantage over us. Because of this fact, we must prepare for the worst, and hope for the best.

Due to the nature of a biological and chemical weapon attack, our response planning must address two fundamental aspects. First, response plans must be developed through a viewpoint of public health. These types of weapons do not destroy buildings, they infect or contaminate people causing illness, injury, or death. The second aspect is one of general public safety. Government and law enforcement agencies must understand both the physical and psychological impact that this type of incident may have on the general public, as well as the overall security of the environment. A terrorist incident of this nature has the potential of causing widespread fear and panic among the public. This emotional response from the public may result in a breakdown in public order. Government, on all levels, should prepare to address this reality and develop plans for reestablishing trust and reducing the fear and panic being experienced by the public. Quick and honest dissemination of information will be effective in assisting with this task. The news media should deliver reports that are factual and designed not to capitalize on the situation. This is why government must be prepared to address details of the incident in an extensive manner. Although the mechanisms of action may vary slightly between biological and chemical agents, the results are usually the same; large numbers of medical casualties. We will first examine how such an event may effect the community from the aspect of a terrorist act involving a biological weapon agent.

Properly disseminated, the effects of biological warfare agents may not be seen for days, or even weeks, after the initial attack has occurred. This is due to the incubation period associated with biological organisms. This fact makes biological terrorism much harder to detect. Theoretically, a terrorist could disseminate a biological agent infecting a civilian population, escape afterwards, and be on the other side of the globe before we even knew what happened. Once the effects of the biological agent begin to surface in the community, it is possible that large numbers of people will have been infected, become symptomatic and seek medical attention. The numbers of infected people would depend upon the type of biological organism used. For example, it has been estimated that the proper dissemination of as little as one pound of Anthrax would be enough to kill the entire population of a major city. In addition, fear and panic among the population is a very real possibility that must be considered following such an incident. An effective method of disseminating public health information would be necessary to inform the public as to what action is being taken, and where to seek medical attention.

In order to respond effectively to such a public health disaster, the need for extensive and prolonged medical services would be required. In a worst case scenario, the ill would be self-referring to local hospitals,

personal physician's offices, outpatient care facilities, pharmacies, etc. at an alarming rate. Police and Fire department telephone systems, and / or 911 emergency systems, would be overloaded with request for assistance. Local Emergency Medical Service (EMS) providers may not have adequate personnel or ambulances to respond and transport all the victims calling for assistance. There would be an increased need for Personal Protection Equipment (PPE), medications, medical and other support equipment that may not be readily available in the aftermath of the incident. Hospitals will have overcrowding, not just from the truly ill victims, but also from many unaffected people that have various nonspecific symptoms, or fear they are infected.

In the event that large numbers of patients, exhibiting similar symptoms, present to local Emergency Departments within a short period of time, Emergency physicians need to have a high index of suspicion that an attack of a biological agent has occurred. The same holds true for private physician's offices receiving unusually large numbers of patients exhibiting similar symptoms. Health Department officials would have to begin a quick and extensive investigation directed toward identifying the biological agent, its method of transmission, and its origin. At the same time, disease onset in a community would be rapid and treatment may need to be implemented quickly to have any effect on mortality, or to ensure effective prophylaxis by implementing PPE, antibiotic therapy, or vaccinations if available.

Some biological agents are communicable, some are not. In an incident involving a communicable agent, an ordered quarantine may be required to stop the possible spread of disease. Non-communicable agents generally do not require quarantine. The possibility of a quarantine following a biological weapon attack may exhaust both hospital and public health resources and personnel. Law enforcement agencies may also become taxed by assisting with an ordered quarantine, in addition to maintaining public order and conducting an investigation into the incident. Problems would also arise with the handling and storage of the deceased, requiring the need for additional mortuary facilities.

The second scenario we will examine is the possible effects to the community caused by the release of a chemical warfare agent. In general, the effects are similar to that of an incident involving the use of a biological agent with a few exceptions. Chemical warfare agents are disseminated in much the same manner as the biologicals, with the primary route of exposure being inhalation or absorption through the skin. The effects of chemical agents are generally more rapidly occurring than biological agents. The effects of a chemical agent may appear within minutes to hours after contamination. Since the effects of chemical agents occurs quickly, identification of the site of release is more easily located, as well as the time of attack. Police and emergency responders should be able to isolate and secure the scene after evacuating people from the area. Having the ability to quickly locate, and isolate, the site of release should limit additional exposure and aid in the investigation process.

If properly disseminated, the effects of a chemical warfare agent would occur quickly and produce large numbers of contaminated casualties at the site of release. The specific effects produced would depend upon the agent involved. These effects may, or may not, be immediately incapacitating in nature. Winds may carry the agent beyond the site of release, contaminating others. Fear and panic among the victims effected should be anticipated. Victims that flee the site of the incident would be self-referring to local hospitals, personal physician's offices, outpatient care facilities, pharmacies, etc. at an alarming rate. The need for extensive medical services and decontamination at both the site of agent release and local hospitals will be required. In addition, there will be an increased need for Personal Protection Equipment (PPE), medication and antidotes, decontamination, medical transportation, and other support equipment that may not be readily available in the aftermath of the incident.

The possibility of a quarantine for chemical agents may not be necessary due to the non-communicable nature of these agents. However, cross-contamination from man to man is possible with many of these chemical agents. Problems may still arise with the handling of the deceased and the need for additional mortuary facilities. Hospitals will have overcrowding not just from the effected victims but also from many unaffected people that have various nonspecific symptoms and believe they may have been contaminated. Emergency response personnel and police would likely be taxed throughout the initial phases of the incident due to the large numbers of victims requiring assistance. However, the situation could improve in as little as a few hours considering the non-communicable nature of chemical agents, and if no additional attacks occurred.

These scenarios are fundamental illustrations of how a community may be impacted by a terrorist act utilizing biological or chemical weapons. It should be remembered that the points outlined in this text only partially portray the problems which might be encountered during one of these types of incidents.

Fundamental Concepts of Terrorism

“Terrorism”, is a word whose usage has become commonplace in today’s society. In the past, the term terrorism was used mainly to describe incidents of a more traditional terrorist nature, such as airplane hijacking, political assassinations and kidnapping, hostage taking, armed assaults by terrorist groups, etc. Today, the term “terrorism” finds itself associated with a wide variety of incidents ranging from politically motivated bombings to domestic violence. Terrorism has been used to describe incidents of school violence, workplace violence, child abuse, church violence, hate crimes, street crimes, etc., in addition to more traditional terrorist acts. Because of this increase in the use of the term “terrorism” to define so many acts of violence in our world today, the term has evolved into a very broad concept that is applicable to many situations, with different meanings for different people or groups. But has the evolution of the definition of terrorism resulted in an improved understanding of this violence, or created more confusion regarding it?

It is often said that “One man’s terrorist is another man’s freedom fighter”. This statement illustrates the common diversity of the term terrorism. One person’s opinion of what terrorism is may be different than that of another person. So then what is “terrorism” and how do we define it? The answer to this question depends upon an individual’s own perspective of terrorism and how it affects them. The same is true for governments that battle with the threat of terrorist violence on a daily basis.

Webster’s Dictionary defines “**terrorism**” as; “the systematic use of terror especially as a means of coercion”, and “**terror**” is defined as; “a state of intense fear”: “one that inspires fear”: “a frightening aspect”: “a cause of anxiety”: “violence committed by groups in order to intimidate a population or government into granting their demands”. This is a general definition of terrorism which can be applied to a wide range of situations, from the school yard bully to an airplane hijacker.

The military definition of terrorism is the one that most accurately fits the traditional model of political terrorism. Terrorism in itself is nothing but a tactic of a larger division of warfare known as “psychological warfare”. Psychological warfare operations are composed of strategies designed to assist conventional military tactics in the defeat of an opposing force through psychological means. These tactics are meant to harass, intimidate, instill fear, unbalance, coerce, etc. these opposing forces. Tactics can include propaganda or dis-information operations, sabotage, assassination, kidnapping, bombings, threats of violence, etc. The use of terrorist tactics such as these have been employed by military forces since the beginning of warfare itself. The military concept of terrorism is usually the foundation for the political definition of terrorism used by most governments.

The political definition of terrorism is generally the one that is accepted as the legal standard for the term. This is due to the fact that terrorism must be defined in such a way that the legislation of laws regarding the concept can be created. And even though the political definition is generally the one which becomes the standard, there is not a single global definition of terrorism that can be agreed upon. Foreign governments, as well as agencies within those governments, may define terrorism in similar terms but also slightly different. This too is usually based upon the perspective of the individual government or agency. The United States Government, for example, defines the term “Federal crime of terrorism” as “an offense that is calculated to influence or affect the conduct of government by intimidation or coercion, or to retaliate against government conduct”, the term is also defined in further detail regarding the nature of offenses. The Federal Bureau of Investigation defines “terrorism” as “the unlawful use of force or violence against persons or property to intimidate or coerce a government, civilian population, or any segment thereof, in furtherance

of political or social objectives.” Both of these definitions have the same basic meaning, they are just worded differently because they are applied in different ways.

In the United States, the Federal Bureau of Investigation’s definition of terrorism is generally the one most commonly used by Law Enforcement agencies, as well as the general public. This is not to say that the FBI’s definition of terrorism is the absolute, however, it does define the basic concept in a simple and concise manner which makes it a very functional definition. It tells us that terrorism is the use of violence against persons or property in the name of political or social objectives. It is important to understand the distinction between the use of violence motivated by political or social reasons, and the use of violence for other reasons. The use of terrorist type violence alone does not qualify as terrorism. A disgruntled ex-employee who bombs his former employer’s building in revenge for being terminated has committed a crime, not an act of terrorism. Violence must be motivated by the furtherance of a political or social agenda before it can be considered an act of terrorism. This political or social element is all important when defining what is, and isn’t terrorism. True terrorism is violence perpetrated, by individuals or groups, with the goal of bringing about political or social change within a government or population. All violence committed which lacks this political or social element will be considered “crime”.

Terrorism Classifications

- **International & Domestic Terrorism**

Terrorism can be divided into two basic categories; international terrorism and domestic terrorism. Fundamentally, both of these types of terrorism are the same when it comes to the threat they present, tactics and weapons used, motivations, group structures, etc. The difference between international and domestic terrorism is found in geographical location.

International terrorism refers to terrorism that is perpetrated against American interest by groups or individuals that are citizens of a foreign country. These terrorist groups or individuals, along with their motivations and ideologies, will originate and reside abroad. These terrorist generally view America as the enemy and whether they attack an American target in a foreign nation or here in the United States, it will still be classified as an act of international terrorism. International terrorism can include classifications such as; State Directed Terrorism, State Sponsored Terrorism, Narco Terrorism, Single Issue Terrorism, Religious Terrorism, and can include the individual terrorist.

Domestic terrorism refers to terrorism that is perpetrated against American interest by Americans. These types of terrorist groups and individuals, along with their motivations and ideologies, originate and reside in the United States. And whether they attack an American target here in the United States or abroad in a foreign country, it will still be classified as domestic terrorism. Domestic terrorism can include classifications such as; Left Wing Terrorism, Right Wing Terrorism, Narco Terrorism, Single Issue Terrorism, Religious Terrorism, and can include the individual terrorist.

- **State Directed Terrorism**

State directed terrorism refers to acts of terrorism against American interests perpetrated by groups or individuals operating as agents of a foreign government. This type of terrorism is generally conducted by nations which consider The United States an enemy. These groups or individuals will have received training, support, funding, and operate under the direct control of that government. Such groups or individuals will

generally be associated with official military or security forces of the foreign government. The motivations for the use of terrorism by a foreign nation could include retaliation for military action, or political and economic sanctions used against that country.

- **State Sponsored Terrorism**

Terrorist groups or individuals which receive support from a host nation in the form of training, equipment, funding, and a base of operations, are known as being state sponsored. Terrorist groups or individuals in this category operate independently, and not under the control of the host nation. The terrorist group will have no official connection to the host country, but may operate for the country covertly in return for the support provided. Nations which support terrorism may do so for many different groups of varying ideologies simultaneously. The groups themselves may also be receiving support from other nations as well. In return for this support, these groups would be available to conduct terrorist operations for multiple nations, at the same time advancing their individual group agenda or movement.

- **Single Issue Terrorism**

Single issue terrorism, also known as ‘special interest terrorism’, is a type of terrorism in which a group or individual commits acts of terrorism in the name of one specific cause or movement. This type of terrorism is most commonly seen associated with causes or movements such as abortion, animal rights, environmental issues, etc. Acts of terrorism are generally directed toward corporate or government entities which are viewed as in opposition to the groups movement. These types of terrorist groups or individuals can originate internationally or domestically.

- **Narco Terrorism**

Narco terrorism is violence perpetrated by drug trafficking cartels and organizations. This type of terrorism is primarily directed toward government entities which conduct interdiction operations against the drug organization or other drug trafficking organization viewed as competition. These types of terrorist groups or individuals can originate internationally or domestically.

- **Right Wing Terrorism**

Right Wing Terrorism refers to terrorist groups or individuals who’s ideologies and movements are generally anti-government in nature. The focus of this type of terrorism can be single or multi-issue in nature, and can include issues such as anti-taxation, pro-constitutional rights, anti-law enforcement, anti-federal government, etc. Groups that are associated with Right Wing movements include; Nazi groups, Hate groups, Anti-tax groups, Militias, etc.

- **Left Wing Terrorism**

Left Wing Terrorism refers to terrorist groups or individuals who’s ideologies and movements are generally concerned with social issues. The focus of this type of terrorism is generally single issue in nature, and can include issues such as; anti-abortion, pro-animal rights, pro-environmental, anti-technology, etc.

- **Religious Terrorism**

Religious terrorism is violence perpetrated in the name of some religious doctrine or belief. This type of terrorism can be found associated with groups or individuals from both established mainstream religions, as well as “fringe” religious movements. “Fringe” religions are generally associated with “cults”, while other groups are found to be rooted in mainstream Western, Eastern and Middle Eastern religions. Basic examples of this type of terrorism can be found in incidents of violence associated with the anti-abortion movement in the United States, or with Middle Eastern groups who have declared “Jihad”(Holy War) against the United States. Groups or individuals associated with this type of terrorism are found to be very dedicated to their movements and believe they are being directed by the word of God in most cases. This type of terrorism can be both International or Domestic in nature.

- **Individuals**

Acts of terrorism do not necessarily have to be perpetrated by a group. A lone individual terrorist can pose the same level of threat as an entire group. Some consider the threat of terrorism posed by individuals to be greater in some respects than that of groups. This is due to the fact that the movements of individuals are much more difficult to track than that of groups. The individual can harbor and develop his terrorist agenda and planning in total seclusion without the need of outside assistance. We probably will not know of this individual’s existence until after a terrorist act has been committed. Individuals engaged in terrorism could range from the professional terrorist who makes his living working for terrorist groups or nations, to the average person living in the average community. Either way, it makes this type of terrorism a very dangerous prospect for any government or civilian population.

Tactics And Weapons Of Terrorism

The tactics of terrorism are easy to define and include; political assassination, kidnaping, hostage taking, direct armed assaults, armed facility occupations, hijacking of aviation and ground transportation, bombings, industrial sabotage, propaganda and dis-information campaigns, threats of violence, etc. In general, these tactics are meant to destroy, kill, injure, intimidate, coerce, disrupt and unbalance the established enemy and ultimately force that enemy into political or social change.

Any weapon has the potential for use by a terrorist group, however, some weapons are used more often than others. Bombs are used in the vast majority of terrorist incidents, making the bomb the number one weapon of choice. Statistics point to bombs being used in over 80% of all terrorist incidents. Bombs are used more frequently than any other weapon for several reasons. Bombs are relatively easy and inexpensive to make, easy to conceal and transport, they can be built to suit specific needs, cause extensive amounts of damage to property, injure large numbers of people at one time, and inflict great fear or psychological terror on the community.

Firearms are the second most widely used weapon of terrorism. Firearms are designed to do but one thing, inflict deadly force upon another. We in the United States understand this concept very well, because we live with firearms violence on a daily basis. Firearms and ammunition are available globally through civilian, military or black market sources. Firearms are easily concealed and transportable, require only minimum skill to operate, and are capable of creating extensive damage both physically and psychologically. We all understand the terror associated with images of a man in a mask carrying an assault weapon.

In addition to bombs and firearms, attention recently has begun to focus on what are known as Weapons of Mass Destruction (WMD). Weapons of Mass Destruction are specifically designed to result in the death or injury to large numbers of people at one time. These Weapons of Mass Destruction fall into four basic categories: Nuclear Weapons, Biological Weapons, Chemical Weapons, and Large Conventional or Improvised Bombs.

Nuclear Weapons pose the greatest threat of potential death and destruction, however, their potential for use by terrorists is limited due to several factors. Nuclear weapons, and the raw materials used to make these weapons, are strictly controlled on a global wide basis. They are extremely difficult and expensive to make or acquire, and easily detectable by governments using sophisticated radiological monitoring devices.

Biological weapons pose as great a threat as do nuclear weapons, and their potential for use by terrorist groups is thought to be feasible. Biological weapons incorporate the use of diseases such as Anthrax, Smallpox, Plague, or any other number of biological organisms as weapons. The majority of these biological organisms are available in nature and require only minimal scientific knowledge and equipment to produce them as weapons.

Chemical weapons also pose a high threat for potential use by terrorist groups, but pose less of a threat of damaging effects than do Nuclear or Biological weapons. This is due to the nature of chemical compounds in general. While chemical weapons may have a quicker and more devastating initial effect when released, they don't have the wide spread effect of a biological weapon because they are not communicable agents. There are no "outbreaks" associated with the use of chemical agents, however, they can be very lethal and cause extensive contamination at the site of usage. Chemical weapons also do not possess the sheer destructive power of a nuclear weapon. The real threat associated with chemical weapons is in the fact that chemicals are available in every community in the United States, making their use as a potential weapon extremely high.

The last category of Weapons of Mass Destruction is large explosive devices. These bombs may be conventional military devices such as missiles and aerial bombs, or improvised devices such as large vehicle or truck bombs. Their potential for use by terrorist groups is extremely high due to the fact that they have already been used on several occasions in the recent past. Examples of the use of such devices can be found in the incidents involving the Murrah Federal Building in Oklahoma, the World Trade Center in New York, and the bombings of two American Embassies in Africa. These types of devices are easy to manufacture, with the necessary components being widely available globally.

Another weapon of terrorism which is becoming more widely considered and feared is the computer. Computers can be used to launch information warfare attacks upon governments, the military, corporations, or private citizens. While still in its infancy, Cyber-Terrorism is now considered a real threat to national security, economic trade, critical infrastructure, corporate and personal privacy, etc. However, information warfare itself is not a new concept and has always been a tactic used by terrorists. Today's sophisticated technologies and communications allow for the waging of information warfare on an unprecedented scale. Through the use of a portable laptop computer and modem, a terrorist can launch an attack against an enemy's computer system through the Internet from anywhere in the world. These attacks could be designed to steal or corrupt information, deny access to a system, destroy the system, or any other related form of damage.

The Structure Of A Terrorist Group

In the traditional model of a terrorist group, we see that the organizational structure is similar to that of any business. There is a leadership element, an active operational element, support elements, etc. all working together for the common goal of the group. Generally, the size of the group's membership base will increase and widen from the top, extending downward. You can expect to see more active operational members than leaders, and more support members than active members, etc. The following chart identifies the core membership sections of the typical large terrorist group.

- **The Leadership Section**

The task of leadership in the terrorist group will generally be similar to that of the leadership of any other organization. The leadership section of the terrorist group would be responsible for the overall management of the group, developing group philosophies and goals, operational planning, group development, providing direction for the members, etc.. Terrorist leaders are generally highly intelligent and motivated, well educated, possess good leadership qualities, are charismatic, etc. They would also be responsible for obtaining and maintaining financial and political support for the group.

- **Intelligence Support Section**

Members of the intelligence section of the terrorist group would be tasked with information gathering responsibilities. These members would conduct surveillance activities against possible targets, conduct information research to assist planning and operational elements of the group, etc. Surveillance methods utilized by terrorist groups could include, wiretapping, physical surveillance, computer system intrusion, open source information research, internet research, video and photographic surveillance, etc. Information may also be obtained through paid informants working for the group. The extent and sophistication of the group's intelligence gathering apparatus is only limited by the group's imagination and resources.

- **Active Support Section**

Active support members could be tasked with any number of group functions. In smaller terrorist groups, the active membership element could be responsible for the bulk of the group's activities. These members could be responsible for creating and distributing group propaganda, acquiring and maintaining group safe-houses, logistical support, transportation, intelligence gathering, executing operational aspects, member recruitment, etc.. Generally, the active support element of a terrorist group would contain the most members compared to other elements of the group. This section could include members from a wide variety of occupations and backgrounds, depending upon the skills and resources needed by the group. Active members could include various skilled laborers, mechanics, medical or scientific personnel, merchants or businessmen, individuals with military experience, etc.

- **Tactical Support Section**

Members of the tactical section would be responsible for conducting the active operational requirements of the group. These members would conduct the actual terrorist acts, which could include bombings, hi-jacking, kidnapping, assassinations, etc. These members would have received training in the use of weaponry, military style tactics, bomb making, etc. They may have backgrounds in traditional military services, have a firm

dedication to the group's goals, and capable of using violence to achieve those goals. Tactical support members may also be responsible for providing security for the group and for providing training to other members. Depending upon the size and resources of the group, tactical support members could either be paid professionals hired by the group, or dedicated followers of the group's movement, or a combination of both.

- **Passive Support Element**

Generally, passive support members are those individuals which provide support to the group's movement, but don't participate in active or violent operational functions. These members may support the group in the form of conducting protest or marches to raise public awareness of the group's movement, provide logistical support, contribute financially to the group, etc. A cross section of the general population may be represented in this section and could include family and friends of active members.

Beyond this general organizational structure, any individual terrorist group could take on its own unique structure depending upon its size and resources. For example, a smaller terrorist group containing only 25 members may be divided into a leadership and operational section only. Due to the small size of the group, there would be no need for several sections tasked with different duties. The operational section would simply provide these functions. In addition, a large terrorist group may divide itself even further into what is referred to as "cells".

These cells are smaller sections of the parent group operating independently, but under the direction of the parent group. Cell groups can operate as a smaller version of the parent group, maintaining the same organizational structure or operate under a narrow chain of command. The size and structure of the cell would greatly depend upon the nature of the cell's operational responsibility. For example, a large terrorist group based in a Middle Eastern country may deploy and maintain a smaller branch of the group in a European country. The smaller cell group located in the European country may be structured and responsible for the same operational goals as the parent group. The cell would contain a leadership, active and passive support elements, tactical elements, etc., except on a smaller scale. A cell could also be composed of members from a single operational element of the parent group tasked with a specific function. The cell may be solely responsible for intelligence gathering, propaganda publishing and distribution, carrying out terrorist attacks, etc.. Due to the small nature of cell groups, the parent terrorist organization could deploy several cells to different geographical locations simultaneously. These cell groups may even operate without knowledge of each other, making them more difficult to track.

Potential Targets Of Terrorism

The answer to the question 'Who is a potential target of terrorism?' is an easy one. Any individual, corporation, organization, government, nation or civilian population located on the globe is a potential target for terrorism. No one is absolutely immune from this type of violence, the very nature of terrorism assures that truth. At one time or another, entities from every sector of our society, as well as the global community, have fallen prey to the violence of terrorism. Buildings are bombed, planes hi-jacked, government and corporate officials are kidnaped or assassinated, nations threatened, soldiers and citizens murdered, etc, etc. Incidents such as these have occurred and will continue to occur, as long as groups or individuals choose to utilize terrorism as a method of airing their grievances. The problem exists in the fact that we can't accurately predict when and where the next act of terrorism will occur, or what the nature of that act will be. This reality is the underlying reason for the effectiveness of terrorism as a psychological, as well as physical, weapon. Even if you are not the victim of a direct act of terrorism, you're affected collaterally by the fear,

anxiety, distrust, and uncertainty that an act of terrorism creates. And while it may be true that in general anyone can fall victim to an act of terrorism, certain types of targets present themselves as tactically more attractive than others. These include such targets as:

- Federal, State or Local government facilities
- Political or corporate officials
- Military facilities
- Public transportation systems
- Corporate and industrial facilities
- Public events
- Historic landmarks
- Educational facilities
- Public utilities
- Nuclear energy facilities
- Computer systems and networks
- Food or water supplies
- Consumer products
- Agriculture and livestock

Terrorist Target Selection

How do terrorists select their targets? The answer to this question is a little more complex than one might think. On the surface it would appear that incidents of terrorism occur randomly, as if out of the clear blue. News reports often refer to terrorism as random acts of senseless violence which, for the most part, occur for little or no reason. In reality, nothing could be further from the truth. Yes, while the victims of a terrorist act may be random, the act itself is not.

A terrorist is, in much the same way, similar to a common criminal. Criminal acts are also not random in nature. A criminal must possess the desire, the ability, and the opportunity to commit a crime. Desire, ability and opportunity are therefore known as the elements of the crime, and their presence establishes some degree of pre-planning. Just as the criminal will conduct planning prior to committing a burglary, robbery, murder, car-jacking, theft, or any other number of crimes, the terrorist will plan a bombing, hijacking, assassination, etc. This process of planning removes the element of randomness in the act. What appears random to the average citizen is actually thought out in advance. Where randomness does play a part is in the fact that several terrorist incidents may have nothing in common with each other. The acts may have occurred at different times and places, may have employed different tactics, or were perpetrated by different groups for completely different motivations.

To better understand how terrorists select potential targets we will examine several key elements of the process. First we will assume the terrorist or terror group possesses the desire to commit an act of terrorism. Desire, which could also be called motivation, is the psychological element in the overall process. It is the underlying reason for the act. The intended target may or may not know the motivation for the attack prior to it happening. The terrorist may issue public statements or threats regarding his motivations prior to an attack, or wait until after the attack when responsibility is claimed. The terrorist may also never communicate the motivation for the attack, leaving us to wonder why?. The motivations which fuel the terrorists act are many and can be simple in nature, or very complex. Motivations for committing terrorist acts include:

- The furthering of political, social or religious agendas
- Bringing public awareness to the group's cause or movement
- Creating panic, fear and distrust among a target population
- Destruction of industrial capabilities
- Revenge
- Morale building within the group or movement
- Financial gain
- Assisting with the defeat of an opposing military force

In addition to desire, we will also assume the terrorist or terror group has the ability to commit such acts. Ability is the physical element in the process and includes all the necessary skills, knowledge, equipment and resources needed to carry out the attack. Lastly we have opportunity, the element which creates the need for selecting a target. Because without a target to attack, desire and ability alone would accomplish nothing for the terrorist or terror group.

It is in the process of searching for the right opportunity to commit the act of terrorism that target selection becomes so important. Selecting the right target will require the terrorist or terror group to conduct research and planning. The criteria used by terrorists to select their targets is composed of several elements. If the target fits the operational elements of this selection criteria, it may be chosen for attack. The selection criteria is as follows:

- **Accessibility.** To be able to successfully attack the target, the terrorist must penetrate the target's defenses. Does the target allow easy access by the terrorist?
- **Vulnerability.** Even if the terrorist gains access to the target, is the target vulnerable to attack? Targets are generally categorized as either "soft targets" or "hard targets". A soft target is one in which the potential target employs lower levels of security measures. This type of target is considered easily vulnerable to the terrorist's attack. A hard target is one in which the potential target employs higher levels of security measures, making it more difficult to attack.
- **Suitability.** Is the target suitable to the group's political or operational objectives? Who has the group declared as the enemy? Does this target represent the established enemy?
- **Recuperability.** How quickly can the target recuperate from the attack? The goal will be to disrupt the target's operation for as long as possible.
- **Effect on the group.** Will attacking the target create the intended effect for the terror organization? Will this effect on the group be positive in the eyes of its supporters?
- **Risk.** What is the risk to the operational element conducting the attack? Can the terrorists escape after the attack? What is the risk of confronting police or government agents?

The degree to which each of the elements of the above criteria are applied will greatly depend upon the terrorist group's operational requirements. For example, if the terrorist group's plan calls for the suicide bombing of a target, then the risk posed to the attacker is of less importance than accessibility. In general, it would be valid to assume that if a potential target fits the above criteria, the terrorist group may consider it viable for attack.

Terrorist Intelligence Gathering Operations

Once the terrorist group has selected a specific target, the next phase of planning will be to obtain detailed information regarding the target's operation. This information will prove critical to either the success or failure of the attack. The extent to which a terrorist group is willing to go to obtain intelligence regarding an intended target, will depend upon several key issues; the type of target, security measures employed by the target, the type of attack (i.e.; bombing, kidnaping, hi-jacking, assassination, etc.), and the financial and technical resources of the group. It is not uncommon for terrorist groups to conduct extensive intelligence gathering operations against a potential target. These intelligence gathering operations can last anywhere from several hours to several years depending upon the operational requirements of the attack, and can employ both simple and sophisticated methods for obtaining information.

Intelligence gathering methods are categorized several different ways depending upon the techniques used to obtain the information. A terrorist group may employ intelligence gathering techniques from any or all of these categories depending upon the time constraints of the operation and the resources available to the group.

- **Physical Surveillance.** The terrorist group may deploy its operatives to conduct physical surveillance of the target. Physical surveillance techniques may include following the intended target in order to study specific movements, travel routes, types of vehicles used, security measures employed, places of residence or leisure activities, identification of family members, etc. Physical surveillance may be conducted at a target facility to obtain operational information regarding access control procedures, security measures, company routines, opening and closing times, delivery schedules, etc. Operatives conducting the surveillance will maintain detailed notes regarding all aspects of the target, and may include photograph and video documentation as well.
- **Technical Surveillance.** Technical surveillance methods such as wiretapping or eavesdropping may be employed against the target. These information gathering techniques can be used against corporate and residential communication systems and can include attacks against cellular telephones and fax machines. The penetration of corporate and personal computer systems may also be attempted with the goal of obtaining information. Electronic tracking devices may be placed on target vehicles to monitor their movement.
- **Open Source Intelligence.** Open source intelligence is information obtained from sources freely available to the public. These sources include newspaper and magazine articles, trade publications, telephone books, travel maps, public records, television news reports, business associations, etc. The Internet is also a major source of easily assessable information. Corporate and personal web sites often contain extensive background information, and can be viewed by anyone with access to the World Wide Web.
- **Human Intelligence.** Information may be obtained from individuals who have personal knowledge of the activities of the potential target. These individuals may be current or former employees, contractors, or vendors of the target organization who are disgruntled or support the terrorist group's movement. Depending upon the relationship between these individuals and the terrorist group, financial profit is the likely motivation for supplying the information.

Planning the Terror Attack

Once all information regarding the target has been collected, the terrorist group will move into the final phase of planning for the attack. In the final phase, the terrorist group will study all information about the target in order to discover vulnerabilities which can be exploited. The group will then begin to assemble the weapons, equipment and manpower necessary to perform the intended attack. The group may rehearse the plan prior to actually committing the attack. This rehearsal will usually be done under the actual conditions the group will confront during the real attack. The group will then set a date and time for the actual attack to be carried out. Often the time and date of the attack will coincide with some significant anniversary or historical date in time. This type of date selection is meant to demonstrate the political nature of the attack. It should be noted that even if the attack fails to achieve the intended result, it would still be considered successful in the respect that the group was able to reach the operational stage in the first place.

BioCrime and ChemiCrime: A New Threat Paradigm

The threat we face from Weapons of Mass Destruction is typically associated with a terrorist action or an act carried out by a foreign nation. The vast majority of our current thought regarding the Weapons of Mass Destruction problem is directed toward this end. In addition, the bulk of our current preparedness activities center around response to an attack perpetrated by terrorists or foreign governments. In general, this way of thinking is both valid and necessary because terrorists or foreign nations which desire to use these types of weapons against us present a very real threat. Weapons of Mass Destruction were designed to be used as tactical weapons in the theater of war. Terrorism, which many consider an act of war, has its roots grounded in a division of conventional warfare primarily known as Psychological Warfare. Terrorism has always been considered a tactic of military strategy throughout the history of warfare itself. However, as time moves forward, all things tend to evolve, as they always seem to do. Today terrorism is defined as the use of force to bring about social or political change. No longer considered only a military concept, terrorism has become a tactic used by many special interest movements grounded in social and political issues. This is how we view terrorism today because that is how we define it. Acts of terrorism perpetrated against American interest and citizens can bring about serious repercussions directed toward the offender. The United States government considers terrorism a very serious issue and response planning is geared toward using vast federal resources for both crisis and consequence management of such incidents. These federal resources would be readily available to assist any U.S. community that has become the target of a terrorist attack. This current government preparedness paradigm, while comprehensive, fails to address the following scenario; the use of a Weapon of Mass Destruction for purposes other than terrorism.

It must be remembered that terrorism is a concept. A Weapon of Mass Destruction is just that, a weapon. So what happens when such a weapon is used by an individual or group motivated by reasons other than terrorism? The answer to this question is, a crime occurs. While biological and chemical terrorism are concepts familiar to both the public and emergency response community, the concepts of BioCrime and ChemiCrime are new and not widely spoken of or planned for. These concepts present us with an entirely new threat that will challenge our standard way of preparing for incidents involving Weapons of Mass Destruction. While it is true that terrorism is in fact a crime, acts of terrorism result in specific responses that have not been designated for an act of criminality. For example, if a terrorist group introduced a chemical weapon agent into an office building injuring 50 people, the act would fall under the jurisdiction of the federal government due to terrorism being a federal crime. The Federal Bureau of Investigation (FBI) being the lead agency in charge of investigating acts of terrorism would be able to call into use extensive government resources to manage the incident. On the other hand, what if a disgruntled employee injured 50

co-workers by introducing a chemical agent into their former employer's office building in retaliation for being terminated from a job. Would this type of incident, which is technically classified as an act of workplace violence, result in the deployment of these extensive federal resources? More than likely, such an incident would not result in a response from federal authorities beyond standard investigative and technical assistance. This is due to the fact that current response planning addresses incidents of terrorism, not criminal use of these types of agents. However, if this type of workplace violence scenario could be classified as a disaster, then certain state and federal resources could be deployed to assist local responders. While this point could be an issue of debate, it is meant to illustrate the importance of understanding that biological and chemical agents could possibly be used for reasons other than to make social or political statements.

The concepts of BioCrime and ChemiCrime are important to consider from the perspective of local emergency response planning. Motivations for criminal activity can include revenge, financial gain, vandalism, psychopathic fantasies, etc. Motivations such as these, combined with a biological or chemical weapon, could present the emergency response community with problems beyond their normal response planning. For example, training scenarios designed to illustrate the threat from biological and chemical agents typically depict situations such as, a plane flying over a city spraying an agent, or the city's water utility being tampered with, etc. While these scenarios do depict possible methods of attack, they are based on models which represents mass area contamination similar to that of a military weapon deployment. Preparedness for civilian communities must include these types of possible attacks from other nations, but should also include scenarios which represent trends in our own society. Consider the fact that standard riot control agents, such as pepper spray, are classified as chemical weapons. Now think about how frequently an incident occurs involving the release of these chemical agents into buildings or schools causing mass evacuations and injured victims. These events occur many times annually in communities across America and collectively effect thousands of individuals. However, these events are not considered, or reported as, chemical weapon attacks which indeed they are. What these types of incidents are not is terrorism. They are criminal incidents involving the use of a chemical agent as a weapon. These events do not result in the deployment of state or federal resources, but are handled by the local emergency response community. The next obvious question is then, what happens if the next time such an incident occurs the weapon agent of choice is not pepper spray, but a nerve agent? Would our current response protocols be adequate to handle such an incident? Are we as a society prepared to respond not only to acts of terrorism, but to a wide range of criminal scenarios involving biological and chemical agents used as weapons?

Characteristics of Biological Weapon Agents

Biological warfare is the use of microorganisms (bacteria, viruses, and fungi) or toxins (poisons from living organisms) to produce death or disease in humans, animals, and plants. Biological agents are the oldest of the nuclear, biological, chemical (NBC) triad and have been used by governments in warfare for 2,500 years. These biological agents are more deadly on a compound per weight basis than chemical agents. Biologic agents occur naturally in the environment, but many have been refined and could be made more resistant in laboratories.

During the 1991 Persian Gulf War, the threat of biological warfare against American soldiers increased the public awareness of the possibility of a potential biological attack against U.S. cities. The reality of this threat gained credence in 1996 when two high ranking Iraqi military officials revealed that during the war, Iraq had produced and was prepared to use 19,000 liters of botulinum toxin and 8,500 liters of anthrax.

Rogue nations and terrorist organizations have shown a strong interest in the use of biological weapons (BW) because these weapons are inexpensive to produce, difficult to monitor, and can produce illness and death in large numbers of people. Called “the poor man’s nuclear bomb”, biological weapons can be produced with minimal startup equipment and supplies, and can be introduced easily into areas with large groups of people. Several nations and many foreign and domestic terrorist groups are suspected of possessing biological weapons, or the equipment and components necessary to manufacture such agents. These agents are appealing to countries or terrorist groups with limited resources.

In 1984, members of the Rajneesh Cult, a religious extremist group, used salmonella bacteria to contaminate food items on salad bars in ten restaurants located in the City of Dalles, Oregon. The purpose of this act was to cause illness among towns people in the hopes of influencing a local election. This act resulted in 750 individuals developing salmonellosis, of which 60 were hospitalized. All individuals recovered from the illness. Several group members were arrested, and later convicted of the crime. During the investigation it was reported that the group had been experimenting with attempts to aerosolize HIV contaminated blood.

General Characteristics of Biological Agents

Biological agents may be found in the form of bulk or compacted powders, gels, or liquids. Their intended effects, determined by the terrorist group, can be incapacitating or lethal and may be communicable or non-communicable. Biological warfare agents have the potential for causing widespread illness and death.

Bacteria are single-celled microorganisms that vary in shape depending on the makeup of their cell wall. Cocci are 0.5 to 1 micron in size. Bacilli are 1 to 5 microns in size. Bacteria are self-sustaining organisms that do not require a host to reproduce. Some types, such as anthrax, may transform into a spore (hardened shell) and remain alive in a dormant state for many years.

Viruses are the simplest type of microorganism and are composed of only genetic material (RNA or DNA) surrounded by a protein coat. Viruses are much smaller than bacteria and require a host to function and survive. This host can be plant, animal, insect, bacteria, or human. Many viruses attack a specific type of cell causing disease or cancer.

Biological toxins are nonliving, poisonous chemical compounds that are produced by living organisms (animals, plants, and microorganisms). Biological toxins produce illness and disease by a variety of mechanisms, including interfering with nerve conduction, interacting with the immune system, and inhibiting protein synthesis. Toxins are more toxic per weight than manmade chemical agents, but unlike chemicals, toxins are not typically volatile or able to cause illness through skin absorption, with exception to the T2 mycotoxin. Person-to-person transmission does not occur and toxins are not very persistent when released. The toxicity of these agents varies by the route of entry into the body.

The primary route of infection for biological weapon agents is by inhalation, although other routes such as ingestion, dermal abrasion, and intentional percutaneous routes have proven effective. Since biological weapon agents are nonvolatile (do not evaporate), they must be dispersed in aerosols as 1 to 5 micron size particles (1/30,000 of the diameter of a hair follicle). At this size, particles deposit deep into the terminal air sacs of the lungs causing disease. Smaller particles do not remain in the lungs and larger particles are too large to reach the lungs.

Developing a biological organism for use as a weapon is not an easy task. The ideal biological weapon agent:

- Can be delivered as an aerosol
- The organism can be readily obtained
- Has a high disease / infection ratio
- Maintains viability / infectivity in environment
- Easily synthesized by an attacker with the proper knowledge
- Has a vaccine or other prophylaxis to protect the attacker

√ Only a few of the thousands of known microorganisms meet these requirements.

Dissemination Methods

Dissemination of each of these agents can occur by various methods such as aerosolizing, vaporization, or vector borne (carried by insects and rodents). Direct injection of biological toxins have occurred in several instances of assassination. Military weapons have also been designed to deliver biological weapon agents in missile warheads and aerial bombs.

Other possible dissemination routes for biological agents may include food and drink sources. Past incidents of product tampering and food contamination have shown to be effective routes for dissemination of harmful substances. After an initial attack using a biological agent, man to man transmission of the disease is also possible with those agents which are communicable.

Environmental Constraints

A biological weapon agent is a living organism, with the exception of toxins which are proteins. Because the agents are in fact living organisms, they have a tendency to be very delicate in their make-up. Most do not retain their viability for long periods of time outside a human or animal host. Commercial cleaning and disinfecting solutions have proven effective at destroying these biological agents on surfaces. Biological weapon agents are affected by a number of environmental conditions.

- Sunlight kills many biological agents.
- Winds will spread the biological agents farther, but also may contribute to diluting their effectiveness. However, the effects wind may have on any particular biological agent will depend upon several factors such as wind speed, wind direction, and terrain.
- Heavy rains may also have a diluting effect on these agents as well. Standing water may create an environment for growth of biological agents.
- Temperature may also effect biological agents. Some agents are very sensitive to extremes of heat and cold. However, most are resistant to freezing.
- Desiccation may effect biological agents by causing inactivity or inhibiting growth.

Epidemiologic Clues

Symptoms that would develop after a biological weapon attack would be delayed and nonspecific, making the initial diagnosis difficult. Healthcare providers should seek a number of clues when trying to identify the cause of an unusual infection outbreak. A biological weapon attack should be considered if any of the following are present:

- Large epidemic with unprecedented number of ill or dying.
- HIV(+) or persons with compromised immune systems may have first susceptibility. Additionally, the elderly or children may also be initially susceptible to the effects of the agent.
- Particularly high volumes of patients complaining primarily of respiratory symptoms that are severe and are associated with an unprecedented mortality rate.
- The cause of the infection is unusual or impossible for the particular region (such as Ebola virus which is rarely seen outside of Africa). The agent may require clinical and laboratory diagnosis.
- Multiple, yet simultaneous outbreaks.
- The epidemic is caused by a multi-drug-resistant pathogen, previously unknown.
- Large numbers of sick or dead animals of multiple types are encountered within close proximity to outbreak locations.
- The delivery method or vector for the agent is identified.
- Prior intelligence reports pointing to credible threats within the region or claims by aggressors of a biological weapon attack.

Possible Epidemic Syndromes

- Influenza syndrome
- Pulmonary syndrome
- Jaundice syndrome
- Encephalitis syndrome
- Rash syndrome or cutaneous lesions
- Unexplained death or paralysis
- Septicemia / toxic shock

After a characteristic incubation period following aerosol exposure, most biological weapon agents present as an initial influenza syndrome with fever, chills, malaise, headache, and myalgia. Symptoms may advance into a pulmonary syndrome with radiological changes seen. Liver involvement may be indicated by rising laboratory values. Rashes and skin lesions with or without bleeding abnormalities may occur with some agents. Unexplained death or paralysis may be indicative of the use of biological toxins.

Recognition of these clues or patterns of illness will alert medical personnel that a release of a biological agent may have occurred. Initial interviewing of patients and their families will be necessary to obtain useful epidemiological information for public health officials. Questions asked should focus on the patient's recent history of travel, infectious contacts, employment, and activities of the preceding 3 to 5 days.

Anthrax

Bacillus anthracis is a gram-positive, rod-shaped organism that reverts into a resistant spore under adverse environmental conditions. These spores may be viable and infectious for up to 50 years. Once a spore enters a host, it becomes infectious by germinating into a macrophage. It is then transported to regional lymph nodes where local production of toxins cause edema and death of tissues. Bacteremia, toxemia, and death will follow. Anthrax is an endemic infection in animals, particularly sheep. Humans may naturally become infected if handling contaminated animal fluids or hides, a disease known as “Woolsorters Disease”.

Anthrax causes disease after inoculation of open or minor skin wounds, by ingestion after eating infected meat, or by inhalation of the spores. The inhalation route has the highest mortality rate and is most likely to be used by terrorists. In its wet or dry powder forms, Anthrax is easily disseminated from a spraying device. Untreated skin infections which develop into septicemia have a 20 % mortality rate, 1 % for treated infections. The mortality rate greatly increases to 80 to 90 % mortality rate when anthrax involves the lungs (inhalation) or intestines (ingestion).

Anthrax spores were weaponized by the United States in the 1950's and 1960's before the old U.S. offensive program was terminated. Other countries have been or are suspected of weaponizing this agent as well.

Cutaneous Anthrax

Skin lesions appear 1 to 5 days after spores have been introduced into open skin. Vesicles ranging from 1 to 2 cm in size appear with regional edema and lymphadenitis occurring. Most patients with small lesions may present afebrile. The lesions develop into a painless necrotic ulcer with a black eschar base. The ulcer may spontaneously heal within 2 to 3 weeks, however, 20 % of these cases may develop septicemia and death. Following a major intentional attack, it is possible that cutaneous anthrax cases might appear in conjunction with inhalation cases.

Gastrointestinal Anthrax

Symptoms of gastrointestinal anthrax are variable, but might include fever, nausea, vomiting, abdominal pain, bloody diarrhea, and sometimes a rapidly developing ascites. These patients may present with an acute abdomen. Oropharyngeal cases show primary involvement of the tonsils.

Inhalational Anthrax

Following the inhalation of a small amount of anthrax spores, alveolar macrophages engulf the spores and the bacteria become vegetative. After transportation to the tracheobronchial nodes, a 1 to 6 day incubation period begins. This incubation period is followed by early non-specific symptoms of fever, malaise, myalgias, nonproductive cough, and/or chest discomfort. These symptoms seem to improve over a few days returning with a sudden onset of respiratory distress, dyspnea, and stridor. The chest x-ray may reveal a hilar or mediastinal adenopathy or widened mediastinum with or without a bloody pleural effusion. Typically the chest x-ray does not show evidence of infiltrates. Once toxins elaborate, medications are ineffective. Septicemia, toxic shock, and death usually occurs in 24 to 36 hours.

Diagnosis

Diagnosis is made by the clinical picture of sudden onset of respiratory distress with mediastinal widening on the chest x-ray. Definitive diagnosis is made by a gram stain of blood and blood cultures using routine media, however, these findings may not be evident until late in the course of illness. Only the encapsulated bacteria are visualized. ELISA and immunohistology testing may confirm diagnosis, but samples must be sent to Reference Laboratories.

Treatment

An FDA licensed vaccine is available. The vaccine is a cell-free filtrate, produced by a strain of anthrax that does not cause disease. The vaccine contains no whole bacterium, dead or alive. Since 1970, it has been safely and routinely administered to at risk wool mill workers, veterinarians, laboratory workers, and livestock handlers in the United States. The vaccine is given at 0, 2, and 4 weeks initially with substantial protection after the 4th week. Boosters are given at 6, 12, and 18 months, and followed by yearly inoculations thereafter.

Those patients exposed to known anthrax, or as a prophylaxis measure, should receive ciprofloxacin 500mg PO every 12 hours or doxycycline 100mg PO every 12 hours until 3 doses of the vaccine have been received.

Immunizations for anthrax are initiated along with antibiotic therapy because animal testing suggests the disease will re-emerge in exposed persons after antibiotic therapy is completed. For children, the drug of choice for prophylaxis is penicillin or amoxicillin 20 to 40mg/kg/day as divided doses TID or QID. While naturally occurring anthrax is penicillin sensitive, a genetically engineered BW agent might be resistant. In penicillin-resistant cases, the drug of choice is doxycycline 2 to 4mg/kg/day as divided doses BID.

At the earliest sign of disease, adult patients should be vaccinated and treated with either ciprofloxacin 400mg IV every 8 to 12 hours or doxycycline 100mg IV every 12 hours, until the patient has received 3 doses of the vaccine. Treatment is usually considered futile in patients who have anthrax spores and present with severe mediastinitis, however, antibiotic therapy should still be considered appropriate. Hemodynamic support and airway management may also be required. For treatment of children, IV therapy of penicillin or doxycycline is considered appropriate.

Prevention

No cases of person-to-person transmission of inhalational anthrax have ever been reported. However, cutaneous transmissions have occurred. Universal precautions should be maintained for the duration of illness for cutaneous and inhalational anthrax.

Plague

Yersinia pestis is a gram-negative, rod-shaped organism that causes the disease known as Plague. This organism is non-motile and does not develop into spores such as *Anthrax*. *Yersinia pestis* is killed easily when exposed to disinfectants, sunlight and temperatures above 72° C for 15 minutes, but is resistant to near freezing temperatures and can remain viable in dry sputum, flea feces, and buried bodies. Plague, also known as the “Black Death” of 14th Century Europe which killed over 25 million people, is normally a disease of rodents, but can be spread to humans by fleas living on infected rodents (rats, mice, ground squirrels). Prairie dogs in the southwest U.S. are major reservoirs of plague, therefore, Plague is most commonly seen in the Southwest (Arizona, southern Colorado, New Mexico) and in Pacific states (California, southern Oregon). It has been shown that domestic dogs exhibit a resistance to this infection, however domestic cats are highly susceptible. Transmissibility in man is high and all humans are susceptible to the disease. Effects are usually lethal with a 30 to 100% mortality rate. If recovery from the disease occurs, it may be followed by a temporary immunity. Since 1974, reported cases of Plague average about 16 cases per year in the United States, according to Centers for Disease Control statistics. Nearly all fatal plague cases in the U.S. result from delay in seeking treatment or from improper diagnosis.

Plague produces disease by being consumed by macrophages and is then transported to regional lymph nodes causing regional adenitis. Entry into the blood stream causes infection in secondary organs such as the lungs, spleen, liver, and brain. Infection occurs in three forms: **bubonic**, which involves the lymph nodes closest to the bite of infected fleas (usually lower legs); **pneumonic**, which is an infection of the lungs from inhalation; and **septicemia**, which is a generalized infection in the blood from the bacteria escaping through the lymph nodes or lungs and causing toxic shock. Dissemination can occur naturally from the bites of fleas, but it may also be a terrorist’s weapon and disseminated via aerosol (inhalation) or introduced into food/drink (ingestion).

Bubonic plague

Bubonic plague occurs from the bite of an infected flea. Initial symptoms include erythema, fever, and chills which typically progresses to bubo formation in regional lymph nodes. Septicemia normally develops 2 to 10 days later. Bubo may be aspirated but should not be surgically drained. Gram staining is diagnostic. Bubonic plague may progress spontaneously to the septicemic form involving multi system organs, and may also cause vasculitis, resulting in purpura and thrombosis from stimulating the clotting cascade resulting in gangrene. Bubonic plague is not usually transmitted person to person unless there is contact with pus from draining buboes. Universal precautions and contact isolation should be employed when treating these patients.

Pneumonic plague

After inhaling the organism, either through aerosolization as a Biological Weapon or from respiratory droplets from another infected person, a 2 to 3 day incubation period occurs followed by a sudden onset of high fever, chills, and flu-like symptoms. Within 24 hours, fulminant pneumonia and systemic toxicity are seen. Chest x-ray may show patchy infiltrates or consolidation. Coagulation abnormalities are common and severe ecchymosis may occur (“black death”). Bloody sputum will produce positive cultures for *Yersinia pestis*. This pneumonia progresses rapidly, causing dyspnea, stridor, respiratory failure, and circulatory collapse. Six percent of pneumonia cases have an accompanying meningitis. Acral gangrene may be a late

complication of pneumonic or septicemia plague, and usually occur in the fingers, toes, earlobes, nose, and penis.

Diagnosis

Diagnosis is made by gram stain and cultures of lymph node aspiration, sputum, or CSF samples. Bipolar staining will show a characteristic “safety pin”-shaped organism. Immunoassays are also available. There are few pneumonia's caused by gram negative bacilli other than plague.

Treatment

Antibiotic therapy must be started within 24 hours of the onset of symptoms to impact survival. Streptomycin and doxycycline are the drugs of choice for pneumonic plague. Streptomycin is given 30 mg/kg/day IM divided twice daily for 10 days and doxycycline is given 200 mg IV initially, followed by 100 mg twice daily for 10 days. Chloramphenicol is used for plague meningitis with a dosage of 50 - 75 mg/kg/day in divided doses every 6 hours. Streptomycin or gentamicin are appropriate for IV therapy if child is over 1 year of age. Care is otherwise supportive. Incision and drainage of the lymph nodes is not recommended. After antibiotic therapy is started, the swollen tissue typically resolves on its own.

Prevention

Secondary transmission from person to person is possible with plague. Respiratory droplet isolation with precautions against airborne spread is mandatory for at least the first 48 hours of treatment.

A plague vaccine is available for bubonic plague only. It is not effective against aerosol exposures. Tetracycline or doxycycline can be given as prophylaxis for adults. Doxycycline or trimethoprim / sulfamethoxazole should be considered for pediatric prophylaxis. (Enamel staining of teeth by doxycycline or tetracycline only occurs with multiple repeated courses.)

Tularemia

Francisella tularensis is a non-motile, gram-negative coccobacillus that typically causes disease in animals (rabbit fever, deer fly fever). Humans become infected with the disease by handling contaminated animal fluids or through bites by deer flies, mosquitoes, or ticks. Tularemia does not form spores, but the organism can remain viable for weeks in many environments. It is resistant to freezing, but is sensitive to heat and disinfectants. After infection occurs, bacteria spread to regional lymph nodes and the reticuloendothelial system. Bacteremia with secondary spread to the lungs and other organs follows. Almost all of those exposed to tularemia will become infected. The mortality rate for persons who go untreated is 20 - 30%, with a mortality rate of 5% for treated victims. Recovery is followed by permanent immunity.

Infection occurs via inhalation, ingestion, or absorption. Inhalation is the most deadly route of exposure. Inhaling as few as 10 to 50 organisms will cause disease, whereas millions of organisms must be ingested to produce disease. Ingestion or inoculation, through minor skin lesions or arthropod bites, results in the ulceroglandular form of tularemia. With its easy spread ability, tularemia may be an effective weapon for terrorists.

Symptoms

Within 2 to 10 days after inhalational exposure, there is an abrupt onset of high fever, chills, headache, myalgias, non-productive cough, and pneumonia. If the organism was ingested or inoculated, symptoms will also include regional lymphadenopathy and may or may not have cutaneous ulcers. Pronounced inflammation and necrosis may occur in the lymph nodes, lungs, skin, conjunctiva, or oropharynx. Long term complications may include hepatitis and renal damage.

Diagnosis

Diagnosing tularemia is the greatest problem because growing the organism is difficult and dangerous. Staining of ulcer fluids or sputum is generally not helpful. Diagnosis can be made retrospectively by serology. Tularemia should be suspected in an epidemic febrile illness with pronounced tender lymphadenopathy. Although bubonic plague has the same symptomatology, differential diagnosis is made by the length of the disease course. Bubonic plague has a shorter disease course.

Treatment

Treatment of choice for tularemia in adults is streptomycin 1 gm IM every 12 hours for 10 days. Children are given streptomycin 15 mg/kg IM twice daily for 10 days. Gentamycin 3 mg/kg/day can be used as an alternative.

Prevention

Person to person transmission does not occur, although routine universal precautions should always be employed. Prophylaxis treatment with tetracycline or doxycycline is effective.

A live attenuated vaccine has been in use since 1959 for immunizing of personnel who are at risk of laboratory infection.

Cholera

Vibrio cholerae is a short, curved, motile, gram-negative, non-sporulating rod that produces the disease cholera in humans. These organisms are anaerobes, growing best at a pH of 7.0, but able to tolerate an alkaline environment. They do not invade the intestinal mucosa, but rather adhere to it and excrete an enterotoxin which effects the intestinal epithelial cell and causes severe fluid loss through diarrhea. This large fluid loss originates in the small intestine and overwhelms the capacity of the lower intestine to absorb such large amounts of fluid. Transmission is made through direct or indirect fecal contamination of water or foods, and by heavily soiled hands or utensils. All populations are susceptible, while natural resistance to infection is variable. The organism is easily killed by drying. It is not viable in pure water, but will survive up to 24 hours in sewage, and as long as 6 weeks in certain types of relatively impure water containing organic matter. It can withstand freezing for 3 to 4 days. It is readily killed by dry heat at 117° C, by steam and boiling, by short exposure to ordinary disinfectants, and by chlorination of water.

Cholera has purportedly been investigated in the past as use as a biological weapon. To be an effective incapacitating weapon, major drinking water and/or food supplies would need to be heavily contaminated. Naturally occurring cholera epidemics in South America and Peru have been reported and have shown the devastating consequences of this disease. The mortality rate for cholera can be as high as 50 % in untreated cases.

Symptoms

The incubation period for cholera can be from 1 to 5 days, but on average is usually 2 to 3 days. Symptoms can range from asymptomatic to severe with the sudden onset of nausea, vomiting, abdominal distention, abdominal cramping, little or no fever, and voluminous diarrhea. This 'rice water' diarrhea may cause fluid loss to exceed 5 to 10 liters or more per day. Electrolyte loss can explain all clinical signs and symptoms. Without fluid and electrolyte replacement, death may result from severe dehydration, hypovolemia, and shock.

Diagnosis

Diagnosis is made clinically with the symptoms of 'rice water' diarrhea and dehydration. Microscopic exam of stool samples reveals few or no red or white cells which reflects the non-invasive character of *V. cholerae* infection. The organism can be identified by darkfield or phase contrast microscopy, and by direct visualization of darting motile vibrio.

Treatment

Treatment of cholera is primarily the replacement of electrolytes and fluids. This may be accomplished orally for those patients who are not vomiting. For patients having > 10 liters of diarrhea per day, intravenous electrolyte and fluid hydration will be necessary. Antibiotics will shorten the duration of diarrhea and thereby reduce fluid loss. Tetracycline 500 mg given every 6 hours for 3 days or doxycycline 300 mg once or 100 mg given every 12 hours for 3 days is generally adequate. However, due to widespread tetracycline resistance, ciprofloxacin 500 mg given every 12 hours for 3 days or erythromycin 500 mg given every 6 hours for 3 days should be considered. For pediatric treatment, tetracycline 50 mg/kg/day divided into 4 doses for 3 days can be used, as dental staining has only occurred after > 6 courses of treatment lasting

6 or more days. Alternates are erythromycin 40 mg/kg/day divided into 4 doses for 3 days, trimethoprim 8 mg and sulfamethoxazole 40 mg/kg/day divided into 2 doses for 3 days, and furazolidone 5 mg/kg/day divided into 4 doses for 3 days or 7 mg/kg x one dose.

Prevention

Cholera does not easily spread from person to person. Enteric precautions and careful hand-washing should be employed. Bactericidal solutions such as hypochlorite solution would provide adequate decontamination.

The best way to prevent cholera in an endemic environment is to avoid contaminated water, ice, fruits, vegetables, and also raw or undercooked seafood. A licensed, killed vaccine is available, but it only provides 50 % protection against cholera and lasts less than 6 months. The vaccination schedule is at 0 and 4 weeks, with a booster every 6 months.

Escherichia Coli

E. coli is a gram-negative rod-shaped bacteria and is one of hundreds of strains of Escherichia coli. Most strains are harmless and live in the intestines of healthy humans and animals, but this strain produces a powerful toxin which can cause severe illness. E. coli was first recognized in 1982 when an outbreak of severe bloody diarrhea occurred resulting from contaminated hamburgers. Since then, infections have been linked to eating undercooked, contaminated ground beef. Infection can also occur after drinking raw milk and after swimming in or drinking sewage-contaminated water. Child care centers are also an important mode of transmission since bacteria in diarrheal stools of infected persons can be passed to others if hygiene or handwashing habits are inadequate. This is particularly likely with toddlers who are not toilet trained.

Because E. coli is found on a number of cattle farms, it could be easily obtained by terrorists and dispersed via food supplies to cause an incapacitating illness in large numbers of people.

Symptoms

Symptoms of E. coli infection are usually seen as severe bloody diarrhea with abdominal cramping. In some cases the diarrhea may be non-bloody or the person may be asymptomatic. Usually little or no fever is present and the illness resolves itself in 5 to 10 days without antibiotics or other specific treatment. In some persons, particularly children under the age of 5 and in the elderly, the infection can cause a complication called hemolytic uremic syndrome. In this instance, red blood cells are destroyed causing the kidneys to fail. About 2% to 7% of infections lead to this complication.

Diagnosis

Diagnosis of E. coli is made by detection of the organism in stool specimens. Most laboratories do not routinely test for E. coli, so all persons who suddenly have bloody diarrhea should be tested for E. coli to prevent misdiagnosis and expensive diagnostic procedures.

Treatment

Treatment is supportive with attention to electrolyte and fluid balance. There is no evidence that antibiotic therapy improves the course of disease, and it is thought that treatment with some antibiotics may precipitate kidney complications. Anti-diarrheal agents should also be avoided. The illness usually resolves itself in 5 to 10 days.

Prevention

Person to person transmission does occur. Universal precautions along with precautions for body fluids should be instituted.

As for public safeguards, ground beef and hamburger should be cooked thoroughly. Raw meats should be kept separate from ready-to-eat foods. Counter tops and utensils should be washed with hot soapy water after they touch raw meats. Milk, juice, and cider should have undergone pasteurization before drinking. Fruits and vegetables should be washed thoroughly before eating, especially those that are not going to be cooked.

Q Fever - Rickettsial Type

“Query” fever, or Q fever, is caused by *Coxiella burnetii* which is a highly infectious rickettsia microorganism resistant to heat and drying. A rickettsia is an obligate parasitic bacterium that requires a host to survive, similar to a virus. *C. burnetii* becomes engulfed by a phagocyte where it multiplies and disseminates to multiple organs and the reticuloendothelial system. Initially, this organism causes the host cell to increase its metabolic and functional activity, leading to eventual cell rupture. Q fever typically causes infection in animals such as sheep, cattle, and goats. This organism reactivates in female sheep during pregnancy, with up to a billion organisms found per gram of placenta. Humans can acquire the disease by inhaling aerosols contaminated with the organism. Inhaling only one organism can cause infection.

Q fever is considered probably the very best of the biologicals to be used as an incapacitating agent by terrorists. The primary forms of Q fever can be delivered as a wet liquid or dry powder and can be disseminated by aerosol or as contaminated food/drinks. *C. burnetii* grows well in eggs, it lives long and hardy in air, and will hit the ground before it dies if dispersed by aerosol. Q fever is usually a self-limiting disease in non-immunocompromised individuals, even without treatment. Antibiotics only shorten the course of disease. The mortality rate is less than 1%.

Symptoms

Ten to twenty days after inhalation, there is a sudden onset of an influenza like syndrome with marked anorexia. Symptoms can include fever, chills, blinding headache, general weakness, severe sweats, and chest pains. An atypical pneumonia is seen in 50% of the cases. X-ray may reveal a “ground glass” appearance. One-third of the patients may show elevated liver enzymes. Neck stiffness and CNS signs may also occur. Patients are not generally critically ill. Duration of the illness can last from 2 days to 28 days.

Diagnosis

Q fever is very difficult to diagnose because it resembles so many other community acquired diseases. The diagnosis of Q Fever should be considered when numerous individuals from the same geographical area present with the same non-specific complaints and findings of pneumonia. White blood cell counts are found to be elevated in one third of patients. Most patients with Q fever have a mild elevation of hepatic transaminase levels. Blood cultures are negative and sputum cultures are not usually helpful. Serological tests exist, but are not readily available outside of the military.

Treatment

Treatment for children and adults is usually symptomatic since most cases will resolve even without antibiotic therapy. However, tetracycline 500 mg every 6 hours or doxycycline 100 mg twice daily given orally for 5 to 7 days, will shorten the duration of symptoms.

Prevention

Person to person transmission from patients with Q fever does not occur, although universal precautions should continue to be observed.

An inactivated whole cell vaccine is available, but is not stockpiled for general use. Severe local reactions to the vaccine are possible.

Tetracycline or doxycycline therapy given during the incubation period, or as prophylaxis continued until 8 to 12 days post exposure, may delay or prevent the onset of symptoms depending on when the medication is given.

Smallpox

Variola virus, an Orthopox virus, has caused both minor and major forms of the smallpox disease in the past. With smallpox declared eradicated in 1980, the U.S. stopped its civilian vaccination in 1981, followed by the U.S. military in 1985. Supposedly, only the U.S. and Russia have repositories of the virus, although there are concerns that clandestine stockpiles of the agent still remain. It has also been rumored that the Soviet Union may have weaponized the smallpox agent.

Natural occurrences of smallpox were spread by inhalation of air droplets or as aerosols. Smallpox is a highly contagious agent that could be produced and disseminated easily as a Biological Weapon. The primary forms of smallpox can be delivered as wet droplets or as a dry powder with an aerosol dissemination method. Mortality rates with natural borne exposure in the past were 20 to 40% in previously unvaccinated individuals and 3% in those who had received the vaccine.

In the recent past, we have seen human monkey pox epidemics occur in Zaire. It is possible that this agent could become available to terrorist groups for future use. The overall clinical course of monkeypox in humans is equivalent to that of smallpox, but is milder with a lower mortality rate.

Since the smallpox vaccine is no longer given, and the vaccine that has been given only gives immunity for 10 years, the American public could be at great risk should a terrorist attack using smallpox occur.

Symptoms

Ten to twelve days after airway exposure, influenza-like symptoms such as fever, mild erythematous rash, headache, severe backache and occasional abdominal pains occur. Within 2 to 3 days, exanthema on the face, arms, and hands is noted. Over a period of 8 to 10 days, initial macules become papules and typical pustular vesicles, eventually progressing to scabs. Patients remain contagious until all scabs are healed over. Differential diagnosis is made between varicella (chickenpox) and smallpox with varicella causing crops of lesions that start primarily on the trunk and spread to the extremities. Smallpox lesions are syndronous in their development all over the body.

Diagnosis

Diagnosis is made initially by clinical presentation. Pox virus can also be seen under electron microscope exam from samples taken from vesicles. Variola would be confirmed by tissue culture and genetic typing methods.

Treatment

Treatment is mostly supportive. There is no licensed antiviral medication currently available against pox virus, but experimental evaluations are underway for monkeypox.

Prevention

Smallpox is contagious, therefore patients must be placed in respiratory and skin contact isolation. History shows that only about 30% of exposed individuals subsequently become ill, making it less communicable

than measles and influenza. With previous outbreaks, all contacts were quarantined for at least 17 days. Patients who developed small pox were kept isolated until scabs were completely healed over.

For persons exposed to smallpox, an immune globulin for variola may be accessible through the Centers for Disease Control (CDC). Currently there is a limited supply of variola vaccines available from the CDC.

Venezuelan Equine Encephalitis (VEE)

Venezuelan Equine Encephalitis (VEE) virus is a mosquito-borne alphavirus usually infecting horses, mules, and donkeys. It is endemic in certain parts of the world - Central and South America, Mexico, and Florida. VEE is characterized by inflammation of the meninges of the brain and the brain itself, thus accounting for the predominance of Central Nervous System (CNS) symptoms of the small amount of infections that develop encephalitis. The disease is usually acute, prostrating, and of short duration. VEE is highly infectious with nearly 100% of exposed individuals developing symptoms. If this agent was released intentionally by terrorists, disease might occur simultaneously in both horses and humans. The mortality rate for natural borne infection (through mosquito bites) is about 1%. However, a terrorist use of VEE as an aerosol that was inhaled would be likely to have a considerably higher mortality rate considering the virus is trophic to the olfactory nerves and could gain access to the CNS via this route. Recovery from this infection results in excellent short-term and long-term immunity.

VEE was weaponized by the United States in the 1950's and 1960's before the old U.S. offensive biowarfare program was terminated. Other countries have been or are suspected of weaponizing this agent as well. VEE could be produced in either a wet or dried form and delivered easily as an aerosol. The virus can be destroyed by heat (80° C for 30 minutes) and ordinary disinfectants.

Symptoms

In 1 to 5 days following exposure, symptoms of fever, chills, intense headache, photophobia, myalgias, nausea, vomiting, and diarrhea begin. These symptoms tend to last up to 3 days followed by a prolonged period of weakness and lethargy. Recovery is usually seen in 1 to 2 weeks. Only a small percentage of victims (20% of children, 4% of adults) will exhibit symptoms of meningitis and encephalitis. As mentioned above, if an intentional aerosolized attack occurred, a greater percentage of patients with CNS involvement may be seen. If patients develop CNS symptoms such as meningitis, seizures, change in mental status, or coma, the mortality rate increases to 20%, especially in children. Permanent neurological damage has been reported.

Diagnosis

Immunoassay, viral cultures, or serologic testing may confirm the diagnosis.

Treatment

Treatment is primarily supportive. Currently there are no antiviral medications available. Patients with vomiting and diarrhea may require fluid replacement therapy. Most patients should be treated with pain medications, while those with encephalitis and seizures may require anti-convulsant therapy.

Prevention

Person to person contact does not spread the disease, although Universal precautions should be maintained.

An experimental vaccine has been used in several thousand persons to prevent laboratory infections. The vaccine is given as a 0.5 ml subcutaneous dose. Approximately 18 % of persons vaccinated have failed to

develop detectable neutralizing antibodies, but it is unknown whether they are susceptible to clinical infection if challenged.

Following a Biological Weapon attack, insect spraying should be intensified to areas where mosquito vector species are present to prevent endemic disease.

Viral Hemorrhagic Fevers

Viral Hemorrhagic Fevers (VHF) are a diverse group of illnesses caused by a variety of RNA viruses. These viruses have a wide range of morbidity and mortality. The clinical syndrome in which these viruses cause in humans is called VHF. VHF is caused by four RNA virus families: the Filoviruses, the Bunyaviridae, the Flaviridae, and the Arenaviridae. These viruses use a variety of insect or rodent vectors and include: Ebola, Marburg, Dengue, Yellow Fever, Crimean-Congo Fever, Hantaan Viruses, and Lassa Fever. Each of these viruses has a unique history and is capable of being spread to humans by aerosol or fomite, and by contact with blood and body fluids. Many of these fevers can be treated effectively, except for Ebola. VHF agents, especially Marburg and Ebola have allegedly been considered for weaponization.

Ebola and Marburg, which are filoviruses, were made famous in the non-fiction book “The Hot Zone” and the fictional works of “Executive Orders” and “Outbreak”. Outbreaks of this virus have occurred in Sudan and Zaire in 1976, in Sudan in 1979, and in Zaire in 1995, where there were 300 cases. In the U.S., a related virus (Ebola Reston) was isolated from a group of laboratory monkeys imported from the Philippines in 1989.

Not all infected persons develop VHF. Reasons for this varies depending on various host factors, differences between virus strains, and other immunologic factors. However, a consistency remains between each of these RNA viruses in that the target organ is the vascular bed. Widespread microvascular damage and changes in vascular permeability causes blood leakage from vessels.

Symptoms

Patients with VHF present initially with fever, myalgias, and prostration. Clinical findings may include conjunctival injection, petechial hemorrhages, and hypotension. Full-blown cases will develop into shock with generalized mucous membrane hemorrhaging, involvement of the respiratory, hematopoietic , and central nervous systems. Laboratory evaluation may reveal renal insufficiency, abnormal liver function studies, and elevated bilirubin levels. All of these findings reflect a poor prognosis. Mortality rates range between 50 and 80 % for Ebola strains.

Diagnosis

This diagnosis should be suspected in anyone presenting with a severe febrile illness with evidence of vascular involvement, especially if this person has traveled to known infectious areas. Multiple patients presenting with these same symptoms should serve as a warning to a possible Biological Weapon attack.

Definitive diagnosis requires specific viral studies. Rapid enzymes immunoassays and genetic typing are available at the Centers for Disease Control (CDC), Atlanta, Georgia and the U.S. Army Medical Research Institute of Infectious Diseases (USAMRID), Frederick, Maryland for a number of the viruses. Patient transportation under biohazard safe conditions can also be accomplished by these agencies.

Treatment

Treatment is largely supportive with ICU monitoring to avoid fluid overload (pulmonary edema) while maintaining hemodynamic stability. Comfort measures such as pain medications and sedatives may be required. Blood replacement products may be necessary and systemic coagulopathy should be treated in a

similar manner as DIC. Ribavirin is an antiviral medication that has been used in therapy and prophylaxis for Lassa fever, Hemorrhagic Fever with Renal Syndrome, and Crimean-Congo Hemorrhagic Fever..

Prevention

VHF is transmitted through body fluids, but the exact mechanism is unknown. Animal studies indicate that aerosol transmission is possible, but the disease does not appear to be transmitted by the airborne route. The highest risk of transmission is during the latter stages of the illness, which are characterized by vomiting, diarrhea, shock, and hemorrhage. Patients suspected of having VHF should be isolated in a single room with negative air pressure if possible. Strict barrier-nursing precautions must be enforced. Patients should be cared for at the hospital where they initially presented, since transferring patients may increase the potential for secondary transmission. These viruses are easily inactivated with soaps, detergents, and routine disinfectant solutions. Since most strains of VHF are known to spread in the hospital environment, Universal precautions are essential. In previous outbreaks, simple barrier nursing was enough to reduce health care provider infection rate to virtually zero.

The only established and licensed virus-specific vaccine available for any of the hemorrhagic fever viruses is the Yellow Fever vaccine. This vaccine is mandatory for anyone traveling to endemic areas of Africa and South America. There currently is no vaccine available for the filoviruses or for Dengue Fever.

Botulism

In 1994, the Centers for Disease Control (CDC) reported 34 cases of food borne botulism in the U.S. Most outbreaks result from eating improperly preserved home-canned foods, with vegetables canned in oil being the most common source. Other food sources include homemade salsa, baked potatoes cooked in aluminum foil, cheese sauces, and garlic in oil.

Botulinum toxin, a neurotoxin produced by the bacteria *Clostridium botulinum*, causes the disease botulism. *Clostridium botulinum* is the name of a group of bacteria commonly found in the soil. The bacteria form spores which allow them to survive in a dormant state until exposed to conditions that can support their growth. There are seven types of botulism toxin designated by the letters A through G. Only types A, B, E and F cause illness in humans. Botulinum toxins are the most lethal compounds per weight and are approximately 15,000 times more toxic than the nerve agent VX and 100,000 times more toxic than the nerve agent sarin. Botulinum toxins produce similar effects whether the agent is inhaled or ingested. The primary form of botulinum toxin for use by a terrorist would be in a powdered form and could be disseminated by aerosol (less likely), in consumables such as food and drink (most likely and most effective route), and via projectiles. However, the onset of symptoms varies between hours and days, depending on the route of exposure and the initial dose.

Botulinum works by irreversibly binding to the presynaptic neuromuscular junction and preventing the release of acetylcholine (ACh) there and at cholinergic autonomic sites. This interruption of neurotransmission causes both bulbar palsies and skeletal muscle weakness. A bulbar palsy is a cranial neuropathy that produces a loss of function in the nerves that originate from the brain stem. These conditions do not reverse until the nerves grow back in approximately 6 to 8 weeks.

Symptoms

Within 12 to 36 hours after exposure to the toxin, a descending paralysis (head-to-toe) and bulbar palsies become the characteristic symptoms. Symptoms include blurred vision, mydriasis (dilated pupils), diplopia (double vision), ptosis (drooping eyelids), photophobia, dysarthria, and dysphagia. Soon after, skeletal muscles become weak, starting in the upper body and moving downwards in a symmetrical fashion. Progression of symptoms including respiratory failure will occur in as little as 24 hours. Patients usually remain awake and alert.

Diagnosis

Diagnosis is made from the unique clinical presentation of botulism (bulbar palsies and descending paralysis). Since food borne outbreaks are rare and usually occur only in small clusters, epidemics should arouse suspicion that an intentional release has occurred. Laboratory studies are usually nonspecific. An electromyogram, which is a graphic record of the contraction of a muscle as a result of electrical stimulation, may be helpful in diagnosing the neuromuscular effects of botulism. A mouse neutralization assay may help to confirm the diagnosis. An ELISA test can be performed in specialized laboratories. Cultures of stool specimens may also test positive for botulinum toxin. However, these tests results may take several days to return, therefore, diagnosis should be made on the basis of the case history and physical findings.

Treatment

An antitoxin for botulinum poisoning is available and may be given in an attempt to prevent neurologic progression of moderate, slowly progressive illness, or to shorten the duration of ventilatory failure in those with a severe, rapidly progressing illness. The administration of antitoxin is the only specific therapy available for botulism, and evidence suggests that it is effective only if given very early in the course of neurologic dysfunction. The antitoxin works by neutralizing only the toxin molecules yet unbound to nerve endings. Administration of one 10ml vial of antitoxin by the IV route results in serum levels of type A, B, and E antibodies. It must also be noted that there are a number of adverse side effects including anaphylaxis and serum sickness (horse serum product) associated with the antitoxin. But for the most part, treatment is supportive and may require prolonged respiratory support on a ventilator. If large numbers of patients present with such symptoms, early efforts to procure ventilators will be necessary.

Prevention

Botulism is not transmissible from person to person, however Universal precautions should always be employed.

There are two basic alternatives for prophylaxis from botulinum poisoning: active immunization using a vaccine, or passive immunotherapy using immunoglobulin. A vaccine is currently available to protect Botulism types A thru E. However, this vaccine is in the category of Investigational New Drug (IND) status, with license being held by the CDC. Because the incidence of botulinum poisoning is so low in the United States, vaccination of the general public is uncalled for. It is because of the threat of possible use of botulinum toxin as a biological warfare agent that a vaccine and antiserum development have taken place, with almost entirely of this work being completed by the US Army.

Ricin

Ricin is a potent cytotoxin that is derived from castor beans and is produced as a by-product during castor oil production. Over a million tons of castor beans are used each year in the production of castor oil. When compared with VX, ricin is over 200 times more toxic by weight. Ricin is considered a potential biological weapon because of its worldwide availability. Ricin has been previously used as an assassination agent.

Ricin can be prepared in liquid or crystalline form, or dried into a powder. It can be effectively disseminated by aerosol, introduced into food supplies, and can also be injected, however absorption through intact skin does not occur. Ricin is a very stable compound and is extremely toxic by either of these routes.

Symptoms

Ricin affects the body by blocking protein synthesis within the cell. With inhalation, victims would begin to experience fever, chest tightness, cough, shortness of breath, nausea, and joint pain within 4 to 8 hours after exposure. Ricin causes airway necrosis and pulmonary edema. Death may occur in 36 to 72 hours.

With ingestion of ricin, victims would develop rapid onset of nausea, vomiting, severe diarrhea, and gastrointestinal hemorrhage. Necrosis of the liver, spleen, and kidneys would occur, followed by vascular collapse and death in 3 days.

By injection, ricin causes marked death of muscles and lymph nodes near the site, followed by multiple organ failure leading to death.

Diagnosis

Routine laboratory findings are nonspecific making a diagnosis of ricin very difficult. ELISA testing of blood or immunohistochemical techniques may be used to confirm ricin intoxication. Clinically, ricin inhalation will appear to be very similar to other inhaled corrosives such as phosgene.

Treatment

Treatment is supportive since there is no antitoxin or vaccine available. Ensuring adequate oxygenation and hydration with ICU monitoring is essential. Gastric lavage and activated charcoal is probably indicated following accidental ingestion. If death has not occurred within 3 to 5 days, the patient will usually recover.

Prevention

Victims of ricin exposure are not contagious, therefore, person to person transmission does not occur. Universal precautions should be maintained when there is possible contact with body fluids. There is currently no vaccine or prophylactic antitoxin available for human use, although immunization appears promising in animal models.

Staphylococcal Enterotoxin B (SEB)

SEB is a fever producing exotoxin produced and excreted by the bacteria *Staphylococcus aureus*. Illnesses related to this toxin usually occur after ingesting improperly handled foods that have an overgrowth of staph organisms. Inhalation of SEB does not occur naturally and symptoms will vary depending on the route of exposure. Once this toxin enters the body, it causes a large proliferation of T-cell lymphocytes and stimulates the production and secretion of various interleukins and cytokines. These events are thought to mediate the toxic effects seen with SEB.

SEB is an incapacitating type agent even at sub-lethal doses. Over 80 % of those exposed individuals will develop symptoms. Fatality rate is < 1%. It is most often seen as a dry powder and may be dispersed as an aerosol or introduced into the food supply by terrorists.

Symptoms

With ingestion of SEB, patients will present with symptoms of nausea, vomiting, and diarrhea which may be severe in nature.

With inhalation, sudden onset of high fever (103° to 104° F), chills, headache, generalized myalgias, and non-productive cough are expected to develop within 3 to 12 hours following exposure. Severe shortness of breath and chest pain will develop with larger doses. Chest x-ray will usually be non-specific, but in severe cases, pulmonary edema and acute respiratory disease (ARD's) may develop. Fever may last 2 to 5 days, and cough may persist up to 4 weeks.

Diagnosis

Diagnosis will be difficult since symptoms are similar to endemic community-acquired illnesses such as gastroenteritis and pneumonia. A diagnosis of SEB would be based on a combination of clinical and epidemiological information when large numbers of patients present with the same signs and symptoms over a 24 hour period. Patients with SEB would tend to stabilize quickly, whereas patients with pulmonary anthrax, tularemia pneumonia, or pneumonic plague will progressively worsen (and may die) if untreated.

Treatment

Treatment is largely supportive. For patients with dehydration, fluid replacement will be necessary. Monitoring oxygenation and possible ventilatory support may be needed for those severe cases which develop into pulmonary edema. Most victims recover after the initial acute phase of the illness.

Prevention

Person to person transmission does not occur, but Universal precautions should always be maintained. There currently is no human vaccine available to prevent SEB intoxication.

Trichothecene Mycotoxins (T2)

The trichothecene mycotoxins are low molecular weight nonvolatile toxins produced by several species of filamentous fungi (molds). These toxins are naturally occurring, usually found in improperly stored grains that have become wet and infected with trichothecene producing molds. Trichothecene mycotoxins are stable for long periods of storage and are highly persistent. They are extremely stable to heat and ultraviolet light. These mycotoxins are fast acting potent inhibitors of protein and nucleic acid synthesis. Their main effects are to rapidly proliferate tissues, much like vesicants. Disease results if this toxin is inhaled, ingested, or has contact with skin. Of the various toxins produced, T2 is the most stable, and therefore most likely to be used in a terrorist attack. The potential for use as a Biological Weapon toxin was demonstrated to the Russian military shortly after World War II when flour contaminated with species of *Fusarium* was unknowingly baked into bread that was ingested by civilians. Some developed a protracted lethal illness called alimentary toxic aleukia (ATA). Mycotoxins allegedly have been used in aerosol form (“yellow rain”) to produce lethal and nonlethal casualties in Laos, Kampuchea, and Afghanistan.

Decontamination

Since T2 toxins can adhere to clothing and penetrate the skin, clothing would be contaminated and serve as a reservoir for further toxin exposure. Therefore, outer clothing should be removed quickly and the skin should be washed with soap and water. Eye exposure should be treated with copious saline irrigation. Once decontamination is complete, isolation is not required. Instruments and surfaces should be decontaminated by heating to 500° F for 30 minutes, or may require the use of a hypochlorite solution under alkaline conditions, such as 1% sodium hypochlorite and sodium hydroxide (NaOH) solution with a 1 hour contact time. Standard disinfectants effective against most other Biological Weapon agents are often inadequate to inactivate the very stable mycotoxins. Contaminated clothing and dressings should be steam sterilized, not burned. Burning of contaminated grain and straw has proven to liberate these toxins.

Symptoms

Within minutes of exposure, erythema of the skin accompanied by pain and a burning sensation occurs. Blisters form and progress to necrosis with leathery blackening and sloughing of large areas of skin in lethal cases. Eye pain, tearing, redness, foreign body sensation and blurred vision may follow entry of toxin into the eyes. Inhalational exposure produces a rapid onset of nasal itching and pain, sneezing, rhinorrhea, epistaxis, cough, dyspnea, wheezing, chest pain, and hemoptosis. Anorexia, nausea, vomiting, and watery or bloody diarrhea with abdominal cramping occurs with gastrointestinal toxicity. Systemic toxicity may follow by any route and is manifested by weakness, prostration, dizziness, ataxia, and loss of coordination. These toxins cause radiomimetic injury of intestines, bone marrow, lymph nodes, spleen, and thymus, resulting in leukopenia and bone marrow atrophy. Tachycardia, hypothermia, and hypotension follow in fatal cases. Death may occur in minutes, hours, or days.

Diagnosis

T2 mycotoxins should be suspected if an aerosol attack occurs in the form of “yellow rain” with droplets of yellow fluid contaminating clothes and the environment. With such a rapid onset of symptoms, most chemical and other toxin attacks can be ruled out. Confirmation requires the testing of blood, tissue, and environmental samples.

Treatment

Treatment is largely supportive. There is no specific antidote. Superactivated charcoal should be given to those with gastrointestinal exposure.

Prevention

Close attention must be paid to decontamination of clothing and skin to prevent cross contamination. Once decontamination has occurred, isolation is not required. Universal precautions should be maintained for blood and body fluids. There is currently no vaccine available.

Characteristics of Chemical Weapon Agents

Chemicals were first used as warfare agents during World War I. In 1915, Germany released 168 tons of chlorine onto troops at Ypres, Belgium. In 1917, sulfur mustard was used by German troops again at Ypres, Belgium. The first chlorine attack represented merely an escalation of the existing use of chemicals as irritants. The use of irritating smoke, such as the burning of sulfur, against opposing forces dates back to antiquity.

In March of 1995, the Aum Shinrikyo cult, a religious extremist group, perpetrated a terrorist attack in the Tokyo subway. The weapon used was the chemical nerve agent sarin. This attack resulted in the deaths of 12 individuals and approximately 1000 individuals were moderately to severely injured. Several members of the cult were subsequently arrested and later convicted of the crime.

Various agents can be irritating, incapacitating, can injure or kill. Some agents cause only local effects, some have only systemic effects, while others have both effects. An irritating or incapacitating agent could cause a retreat or render persons unable to advance allowing a terrorist time to accomplish his or her goal.

Some chemicals may evaporate quickly, while others may remain for long periods of time. This is described as their persistency. Persistence can be from minutes to days and is determined by the chemistry of the agent and the environment in which it is used.

Chemical agents can be in the form of solids, powders, liquids or gases. Agents may be inhaled, swallowed, or enter the body through eyes or skin. The effects can be immediate or delayed.

Since chemicals are readily available or easily made, of low cost, are easily transportable, and can be delivered by varying routes, chemicals make an excellent weapon for the terrorist. Most countries, including the United States, are not prepared to deal with a terrorist attack using chemicals.

The following information is designed to provide you with a basic knowledge of these Chemical Warfare agents and their toxic effects. In addition, basic information regarding the decontamination procedures and medical treatment of these chemical agents has also been included. This information is being presented with the goal of assisting medical personnel with the development of a greater understanding of the Chemical Warfare agents which could be used against us by terrorist.

General Characteristics of Chemical Agents

Conventional Chemical Weapon agents, in essence, are derivatives of standard industrial chemicals. The effects these chemical weapon agents have on the human body are similar to those seen in traditional industrial hazardous material accidents. However, Chemical Weapon agents are specifically designed to produce these toxic effects on a larger scale. Chemical Weapon agents such as sarin or VX have the ability to effect hundreds, maybe thousands, of people at one time if properly disseminated. The primary route of exposure to these chemical agents occurs either through inhalation or absorption by mucous membranes and skin, but injury can also occur through ingestion. Unlike biological agents, chemicals are not restrained by the natural barrier created by the skin. This is true for both chemical weapon agents, as well as industrial chemicals. The ideal Chemical Weapon agent:

- Can be delivered as an aerosol
- The chemical can be readily obtained
- Has a high death per dose ratio
- Maintains viability in environment
- Easily synthesized by an attacker with the proper knowledge and equipment
- The attacker can easily protect himself with personal protective equipment (PPE).

Dissemination Methods

Dissemination of each of these agents can occur by various methods such as aerosolizing or vaporization. Prevailing winds can assist with the dissemination of agent in both aerosolizing and vaporization methods. Direct injection of a Chemical Weapon agent could be used in incidents of assassination. Military weapons have also been designed to deliver Chemical Weapon agents in missile warheads and aerial bombs.

Other possible dissemination routes for chemical agents may include food and drink sources. Past incidents of product tampering and food contamination have shown to be effective routes for dissemination of harmful substances. Municipal water supplies may also be a likely target of contamination. After an initial attack using a chemical agent, man to man transmission of the agent may only occur in those agents which have the ability of cross-contamination. Chemical Weapon agents have shown not to be communicable.

Environmental Constraints

Chemical Weapon agents may be affected by a number of environmental conditions.

- Winds will spread the chemical agents further, but also may contribute to diluting their effectiveness. However, the effects wind may have on any particular chemical agent will depend upon several factors such as wind speed, wind direction, and environmental terrain.
- Gravity will also be a factor with chemical agents that are heavier than air.
- Heavy rains may have a diluting effect on these agents as well.
- Temperature may not effect chemical agents as much as biological agents, unless we are taking about temperatures high enough to consume the agent through combustion.

Nerve Agents

Nerve agents are classified as organophosphates which have physiological effects similar to that of many insecticides commonly found in the community. The nerve agents are known as Tabun (GA), Sarin (GB), Soman (GD), and VX. These are the most toxic of all the weaponized military agents. GB, or Sarin, is one of the more commonly stockpiled agents and the most publicly well known due to the Tokyo subway incident.

When dispersed, the more volatile nerve agents constitute both a vapor and liquid threat. Sarin may be inhaled as a vapor, or cause toxic effects by contact with the skin in the liquid form. VX is primarily a liquid skin hazard at normal ambient temperatures. These chemicals are easily absorbed through the skin, eyes, or lungs and can cause sudden loss of consciousness, seizures, apnea and death. Onset of noticeable effects occur from a few seconds to hours after exposure. Nerve agents are designed to irritate, incapacitate, injure or kill.

Characteristics of Nerve Agents

The G-agents are volatile liquids at normal temperatures, although, the most volatile, Sarin, evaporates at about the same rate as water. Nerve agents are stored and transported in the liquid state.

Toxicity and Effects

Nerves communicate with muscles, organs, and other nerves by releasing chemicals, or neurotransmitters, at their connection site (synapse). One of the most common neurotransmitters is acetylcholine (ACh), which is released and collects at the receptor site stimulating the end organ to respond and produce a variety of effects: muscle contractions, gland secretion, and nerve-to-nerve conduction.

When a nerve impulse reaches the synapse, acetylcholine is released from the nerve ending and diffuses across the synaptic junction to combine with receptor sites of the receiving nerve. This causes the electrical message to continue. To stop further stimulation of the nerve, acetylcholine is rapidly broken down by acetylcholinesterase (AChE). Thus, a “check and balance” system prevents the accumulation of acetylcholine and the resultant over-stimulation of nerves, muscles and glands.

The term “nerve agent” refers to chemicals that produce biological effects by inhibiting the enzyme acetylcholinesterase, thus allowing the neurotransmitter acetylcholine to accumulate. As a result of this accumulation, the organ that is normally stimulated has now become over-stimulated which causes hyperactivity of this organ.

The clinical effects of nerve agents are in organs that have cholinergic receptors. These are divided into muscarinic sites (smooth muscles and exocrine glands) and nicotinic sites (skeletal muscles and pre-ganglionic fibers). Over-stimulation at muscarinic sites will increase secretions. The victim may experience increased saliva, tearing, runny nose, phlegm in the airways, and sweating. The accumulated acetylcholine also causes pinpoint pupils (miosis), shortness of breath (bronchoconstriction), and hyperactivity of the gastrointestinal tract (nausea, vomiting, and diarrhea). Over-stimulation of nicotinic receptors causes skeletal muscle fasciculation, twitching, cramping, weakness, and finally paralysis. There is also stimulation of the pre-ganglionic fibers which may contribute to hypertension and tachycardia.

Nerve agents can also have further effects on the cardiovascular system. Bradyarrhythmias, heart block, tachyarrhythmias (sinus tachycardia), and ventricular arrhythmias (ventricular tachycardia and ventricular fibrillation) may occur, but most disappear once the antidote is given.

The central nervous system may be effected in other ways as well. Acute severe effects include loss of consciousness, seizures, and apnea. Effects from a mild exposure include nervousness, fatigue, minor memory disturbances, irritability, and other minor psychological symptoms. These latter symptoms may be prolonged for 4 to 6 weeks following exposure to a nerve agent.

The diagnosis of a nerve agent poisoning must be made clinically. There usually is not time for laboratory confirmation. The combination of pinpoint pupils and muscle fasciculations is the most reliable clinical evidence of organophosphate (nerve agent) poisoning.

Decontamination

Minimum decontamination of patients presenting to the Emergency Department following a vapor exposure should include removal of patient's clothing and jewelry. This will hopefully prevent secondary chemical exposures to hospital personnel due to vapor off-gassing. If the patient has been exposed to high concentrations of vapors or to liquid nerve agent (such as after spraying or an explosion), survivors will require complete decontamination with soap and water, or possibly a decontaminant such as sodium hypochlorite (household bleach) at the scene prior to evacuation. This household bleach should be diluted 1:10 (1 part bleach to 10 parts water) before being applied to the skin, then rinsed off with water. Patients arriving at the Emergency Department with an unclear exposure history who are symptomatic from nerve agent exposure should be fully decontaminated with soap and water or sodium hypochlorite before entering treatment areas.

Airway Management

Establishment of a patent airway is essential for the survival of the severely exposed patient. Severely intoxicated patients will die if aggressive airway management is not quickly available. With large numbers of victims, rapid scene and resource assessment will influence triage decisions regarding interventional therapy. Because of the intense bronchoconstriction and secretions associated with nerve agent exposure, effective ventilation may not be initially possible due to high airway resistance. Adequate atropinization will reverse these muscarinic effects; therefore, atropine should be administered before other measures are attempted. Endotracheal intubation, followed by positive pressure ventilation with an ambu bag, should be preformed as quickly as possible. Periodic suctioning of secretions will help to improve ventilation and air exchange. Patients with seizures and respiratory failure can be saved with immediate and adequate intervention.

Antidote Administration

Three medications are used to treat the signs and symptoms of nerve agent intoxication: atropine sulfate, pralidoxime chloride (2-PAMCl), and diazepam. Each of these should be immediately available in the triage and decontamination areas.

Atropine

Atropine works to block the effects of the accumulated neurotransmitter, acetylcholine (ACh), at muscarinic sites, thus reversing such symptoms as rhinorrhea (nasal secretions), salivation, sweating, bronchoconstriction, bronchorrhea (bronchial secretions), nausea, vomiting and diarrhea. The more ACh at the sites, the more atropine is required to counteract its effects. Atropine can be administered intravenously (IV), intramuscularly (IM), or endotracheally (ET). Atropine given IV should be avoided in hypoxic nerve agent casualties because studies have documented the occurrence of ventricular fibrillation when atropine is administered IV to hypoxic animals.

Atropine will not reverse nicotinic effects such as fasciculation, twitching, seizures, or muscle weakness. Miosis is also not reversed by parenteral atropine, but relief of intractable pain in or around the eye requires the installation of 1% homatropine or atropine topically.

Adult dosage - 2 to 6 mg repeated every 5 to 10 minutes. Dosing is guided by the patient's clinical presentation and should be given until secretions are dry or drying and ventilation becomes less labored. When shortness of breath , increased airway resistance, and secretions have abated and the patient is breathing easier, he or she has received enough atropine. Treatment for chemical nerve agent exposure might require up to 10 to 20 mg of atropine. (In patients poisoned with insecticides, over 2,000 to 3,000 mg of atropine might be necessary.) When atropine therapy exceeds the amount necessary to reverse the effect of the cholinergic hyperstimulation, it may cause toxicity manifested by dry mouth, flushing, and diminished sweating, but this would be extremely unlikely in a patient poisoned by an organophosphate (OP) compound.

Elderly dosage - In the frail or medically compromised adult, use a 1 mg dose and repeat as necessary.

Pediatric dosage - Pediatric experts have divided the age groups for IM administration of atropine. These doses may be repeated as clinically indicated.

<u>Category</u>	<u>Age</u>	<u>Dose</u>
Infant	0 to 2 years	0.5 mg single dose
Child	2 to 10 years	1.0 mg single dose
Adolescent	Young adult	2.0 mg single dose

Pralidoxime chloride (2-PAMCl)

Pralidoxime chloride effects nicotinic sites by breaking the bond between the nerve agent and the enzyme AchE. This will free the enzyme, making it once again available to break down ACh. Once this occurs, an observable decrease in muscle twitching and noticeable improvement in muscle strength will occur allowing the patient to breathe easier. Pralidoxime chloride has little effect on the muscarinic effects described previously.

The bond between the enzyme and the nerve agent can age. This is a process by which the enzyme and agent become irreversibly bound. The aging time for the sarin-enzyme complex is 4 to 6 hours. The aging time for the VX-enzyme complex is 60 hours and the soman-enzyme complex ages in about 2 minutes. If the

antidote is not administered within these time frames, the bond becomes permanent. Usually there is plenty of time to treat patients with 2-PAMCl after exposure to nerve agents with the exception of Soma (GD).

Adult and pediatric dosage - The standard IV dose for a patient from an infant to a 70 kg person is 15mg/kg, with the dose repeated twice at hourly intervals. Above 70 kg, the dose should be a total of 1 gm, repeated twice at hourly intervals as necessary. 2-PAMCl should be placed in 100 ml of saline solution and infused over 15 to 30 minutes.

Elderly dosage - If frail, hypertensive, or with renal disease, use one-half the usual adult dose of 2-PAMCl (7.5 mg/kg).

If hypertension becomes significant during administration of the 2-PAMCl, treat with IV phentolamine as follows:

Adult: 5 mg IV Child: 1 mg IV

For IM use of 2-PAMCl the doses should be :

<u>Weight</u>	<u>Dose</u>
< 20 kg	15 mg/kg
> 20 kg	600 mg autoinjector

These may be adjusted according to subsequent clinical presentation.

MARK 1 kit - Atropine and pralidoxime chloride (PAMCl), are used by the military in autoinjectors which together are called the MARK 1 kit. The atropine autoinjector contains 2 mg of atropine and is administered IM by pressing the end of the device onto the thigh. The other autoinjector contains 600 mg of 2-PAMCl. The Food and Drug Administration (FDA) has approved the autoinjectors for use by the civilian medical community , but local protocols will determine their use in the field. **Mark 1 autoinjector kits should not be used in infants and children due to the risk of injury.**

Dosing for IV administration is 0.02mg / kilogram (kg) for infants up through young adults.

Diazepam

Seizures are treated with benzodiazepines such as diazepam. These medications can be used IV or via an autoinjector which contains 10 mg of diazepam. Some authorities recommend treating all severely exposed patients with diazepam whether they are convulsing or not.

Adult dosage - 10 mg given IV or IM

Pediatric dosage -

Infants > 30 days to age 5	0.2 mg/kg IV slowly every 2 to 5 minutes to maximum dose of 5 mg
Children > 5 years	1 mg IV every 2 to 5 minutes to maximum dose of 10 mg

Vesicants

Vesicants cause blistering of the skin. There are many types of vesicant causing agents such as plants, animals, chemicals and sunlight. As for chemical warfare agents, sulfur mustard and Lewisite are the most commonly referred to. There is no medical pretreatment for blister agents. There is also no specific therapy, only supportive measures.

Sulfur Mustard

Sulfur mustard poses a threat in its vapor and liquid forms. If inhaled, damage to the respiratory tract occurs which can lead to respiratory distress and possibly respiratory failure.

With contact to the eyes and skin, mustard can cause temporary blindness and blistering of the skin. Because of mustard's radiomimetic effects, damage to some internal organs is possible.

If mustard has contact with the skin, it is absorbed and chemical cellular damage occurs within 1 to 2 minutes. There is no immediate pain, there is no immediate skin discoloration or blistering, and there is no immediate eye irritation. Hours later, the casualty realizes that he or she has been exposed. The onset of symptoms ranges from 2 to 48 hours with the most common time frame of 4 to 8 hours.

The exact mechanism by which mustard damages cells is not fully understood. It alkylates DNA and clings to proteins and other cellular components. The end result is DNA damage and cellular death. Because of such cellular destruction, more extensive injury can result in death, due to sepsis, as a result of bone marrow damage, decrease in white blood cells, and an impaired immune system.

Characteristics

Mustard is an oily liquid with a color ranging from a light yellow to brown. Its odor is that of garlic, onion, or mustard, although odor should not be relied upon for detection.

Decontamination

Decontamination must be done as quickly as possible since cellular damage occurs in as little as two minutes. Decontamination of the casualty at the Emergency Department 30 minutes or more after contact with mustard will not change the clinical course of the patient's illness, but will prevent cross-contamination to health care providers. The casualties should remove all clothing, rings, and other jewelry. Skin decontamination may be performed with soap and water or with a 1:10 bleach solution and flushed well with water afterwards.

Eye Injury and Treatment

Eye involvement can range from mild conjunctivitis from a small exposure of mustard, to more severe conjunctivitis, lid inflammation and edema, blepharospasm (twitching or spasmodic contraction of the eye), and corneal roughening with a larger exposure. These more severe effects will cause the casualty to be unable to open their eyes and will render them without sight. A larger exposure, particularly if by liquid, may produce corneal opacification, corneal ulceration, or corneal perforation. Miosis is sometimes observed

after mustard exposure and is thought to be due to cholinergic effects.

Gentle irrigation of eyes with saline or water should be performed initially. Aggressive attempts to pry apart severely painful, blepharospastic eyelids to accomplish an irrigation 30 minutes or more after exposure is of little value, since the damage has been done and the agent has evaporated or has been absorbed. A visual acuity should be obtained prior to initiation of further treatment measures. With severe eye injuries, homatropine or other mydriatics should be applied topically to prevent adhesion formation. Topical analgesics may be used for the initial examination, but further use should be avoided. The instillation of topical steroids may be of benefit if used within the first 24 hours. Topical antibiotics should be applied several times per day and vasoline should be applied to lid edges to prevent them from adhering. Oral analgesics is the preferred route for pain management. The eyes should never be bandaged, although the wearing of sunglasses may be beneficial. Early involvement of an ophthalmologist is advised.

Skin Injury and Treatment

Skin effects begin hours after exposure with erythema accompanied by burning and itching, followed later by the development of small vesicles. Later these small vesicles coalesce to form blisters. The size and depth of the blister formation depends on the amount of the exposure and whether the exposure was from vapor or liquid. Coagulation necrosis, a thick and somewhat hardened scab-like surface that extends into the dermis, may develop under blisters caused by the accumulation of liquid.

Soothing creams or lotions might be effective for irritation and burning. Oral pain medications will also be needed. Large blisters should be debrided and these areas should be irrigated several times a day. Topical antibiotics should be applied to prevent skin bacterial superinfections. Fluid requirements should be addressed, although fluid replacement is much less than with thermal burns. Rarely will burns be full thickness requiring skin grafting.

Airway Injury and Management

When inhaled, mustard damages the mucosa or lining of the airways. This damage begins in the upper airways and descends downward into the lower respiratory tract depending upon the dose exposure. A relatively small exposure may cause upper airway irritation resulting in epistaxis (nose bleed), sore throat, and a hacking cough. A moderate exposure may cause hoarseness, laryngitis with voice loss and a productive cough. A larger exposure which reaches into the lower respiratory tract and effects the bronchioles may produce dyspnea and a productive cough. Because of damage that could occur to the underlying musculature as well, hemorrhagic pulmonary edema is possible, although pulmonary edema is rare.

Upper or minor airway symptoms may be relieved by steam inhalation and cough suppressants. A patient with moderate to severe effects may benefit from oxygen, bronchodilators, steroids, or continuous positive airway pressure (CPAP). For signs of severe upper airway involvement, intubation should be preformed early before laryngeal spasm or edema makes it difficult. The initial chemical pneumonitis should be treated in the usual manner, but antibiotic therapy should not be started until after an organism has been identified.

Gastrointestinal Effects

Initial gastrointestinal effects of nausea and vomiting usually occur within the first 24 hours following an exposure. These effects are due in part to the cholinergic stimulation. Some added effects may be from

swallowed tracheal secretion. Gastrointestinal effects seen after 3 to 5 days are thought to be due to tissue destruction in the abdomen.

Bone Marrow Effects

Absorption of significant amounts of mustard produces damage to and death of the stem or precursor cells of the bone marrow. This causes a decrease in white blood cells, red blood cells, and platelets 3 to 5 days following exposure. The absence of these cells increases susceptibility to infection. Survival is rare if white blood cell (WBC) counts become less than 200. Reverse isolation precautions should be initiated early for those patients who have had a large exposure to mustard.

Lewisite

Lewisite is a vesicant that is rapidly absorbed by the eyes, skin, and lungs. It produces blisters similar to mustard, however, Lewisite is highly irritating on initial exposure. It also produces visible lesions more quickly. Unlike mustard, it does not damage bone marrow.

Characteristics

Lewisite is an oily, colorless liquid with the odor of geraniums. It is more volatile than mustard.

Decontamination

Decontamination must be accomplished prior to allowing entry into the Emergency Department, thus preventing cross-contamination to healthcare providers. Careful removal of the casualties clothing, rings, and jewelry must be accomplished to prevent further exposure of the patient to the agent. Skin decontamination may be performed with soap and water or with a 1:10 bleach solution and flushed well with water afterwards. Irrigation of eyes should be performed using saline solution or water in copious amounts.

Eye Injury and Treatment

Lewisite causes pain and blepharospasm on contact. Edema of the conjunctiva and lids follows and the eyes may be swollen shut within an hour. Iritis and corneal damage may follow if exposure was to a high dose. Treatment protocol for eye injuries from mustard should be referred to when treating Lewisite exposures.

Skin Injury and Treatment

Lewisite causes much greater skin damage than mustard. Skin irritation is seen relatively soon after exposure causing immediate pain or irritation. A gray area of dead skin is often seen prior to progression to blister formation, severe tissue necrosis and sloughing, although the full lesion does not develop for 12 to 18 hours.

Treatments of such blistering tissue damage is the same as for mustard. Patients should be observed closely for signs and symptoms of infection occurring in wounds.

Airway Injury and Management

Lewisite causes immediate irritation to the upper airways. Because of this extreme irritancy to the nasal area and upper airways, it causes the person to mask or exit the area quickly. The airway mucosa is the primary target and damage progresses down the airways in a dose-dependent manner. Further severe lung damage can occur if the person is not removed from the area of contamination quickly. Pseudomembrane formation is commonly seen. Pulmonary edema, which is rarely a complication of mustard exposure, may complicate exposure to Lewisite.

Treatment for upper airway irritation is the same as for mustard exposure. Further complications of airway injury, such as pulmonary edema, must also be addressed as necessary.

Cardiovascular System Damage

Lewisite causes an increase in capillary permeability resulting in intravascular fluid loss, hypovolemia, shock, and organ congestion. This may lead to more prominent gastrointestinal effects that include nausea, vomiting, and diarrhea. With this loss in circulating fluid, careful attention to fluid balance will be an important issue.

Antidote

An antidote is available, called British anti-Lewisite (dimercaprol or BAL), which can be given IM to reduce the systemic effects of the vesicant. As it is administered parenterally, BAL has no effect on Lewisite damage to the skin and eyes. BAL, which is suspended in peanut oil, should not be given to people who are allergic to peanuts.

Pulmonary Agents

Pulmonary intoxicants cause severe life-threatening lung injury after inhalation. These effects are generally delayed several hours after exposure. Treatment is usually supportive and may require advanced intensive care techniques including intubation, use of a mechanical ventilator and the possible use of PEEP. Pulmonary intoxicants included with this group are phosgene and chlorine.

Phosgene

Phosgene is widely used today in the manufacturing of dyes, coal tar, pesticides, and pharmaceuticals. It was widely used on the battlefield in World War I until mustard was introduced.

The Bhopal, India disaster of 1984 at the Union Carbide plant involved the release of 50,000 pounds of methylisocyanate, which is composed of phosgene and methylamine. There were 150,000 people affected, 10,000 severely injured, and 3,000 deaths.

Characteristics

Phosgene is a colorless gas, above 47 degrees F, and is 4 times heavier than air. It is generally transported in its liquid state. As a gas, phosgene is said to have an odor of sweet, freshly mown hay or grass. It is principally a hazard by inhalation.

Decontamination

With vapor exposure only, moving exposed individuals to fresh air should be accomplished quickly and clothing should be removed to prevent off-gassing. If liquid exposure occurs, decontamination with soap and water or flushing with copious amounts of water only, should follow clothing removal to prevent further contamination of the victim and other healthcare providers.

Toxicity

The primary damage from phosgene is from the carbonyl group. Phosgene dissolves slowly in water to form carbon dioxide and hydrochloric acid (HCl). In contact with upper airways, HCl causes a transient irritation of the eyes, nose, sinuses, and throat. A mild cough may also be present due to irritation of the upper airway and bronchi. There usually is a symptom-free period of 2 to 24 hours. Over the first several hours, the carbonyl group from the phosgene attacks the surface of the alveolar capillaries and causes leakage of fluid into the tissues. Eventually, this leakage of up to 1 liter per hour, causes severe hypoxia and apnea. A resulting severe non-cardiogenic pulmonary edema occurs.

Treatment

The leakage of fluid in the lungs causes volume depletion. Although the patient clinically looks like traditional heart failure, **Do Not Give Diuretics!** These patients are volume depleted and hypotension should be treated with fluids. These patients should not exert themselves as well. Early intubation should be considered to protect the patients airway and to manage oxygen delivery prior to laryngeal spasm occurring. The airway should be suctioned frequently to remove secretions. The use of PEEP may also be helpful.

Bronchodilators will usually control bronchospasm, but if not, steroids may be needed for this purpose. Routine steroid use is controversial, but they seemed to offer some efficacy after the Bhopal tragedy. Antibiotic therapy is also a controversial topic. Some sources recommend treatment to be dictated by gram stain and culture results. Other sources recommend prophylactic antibiotics, as autopsy studies show uniform evidence of pneumonia and bronchitis. Once the patient recovers, there should be little residual pulmonary effect.

Chlorine

Chlorine is widely used in the U.S. in the manufacturing of chemicals, plastics, and paper. It is commonly used in laboratories and in swimming pools. Chlorine is a significant irritant to the eyes and respiratory tract. Industrial exposures have produced large numbers of injuries.

Characteristics

Chlorine is found as an amber liquid or greenish-yellow gas that has a characteristic pungent odor. Although generally stored and transported as a liquid, when released, the resulting gas is about two times heavier than air.

Toxicity

Chlorine injures cells by its reaction with water. Together with water, hydrochloric acid and free oxygen radicals are formed which attack cells. Chlorine gas is 30 times more irritating to the respiratory mucosa than HCl.

Chlorine is toxic to any body surface including the eyes, skin, respiratory tract, and GI tract. In seconds after exposure, symptoms of irritation to the eyes and upper airways are noticed. This is followed by irritation of the respiratory tract which generates coughing, shortness of breath, wheezing, and sputum production. Initial respiratory distress is followed by noncardiogenic pulmonary edema in 12 to 24 hours after exposure. Sudden death is usually due to severe hypoxia and cardiac arrest.

Decontamination

Exposed victims should be moved away from the source of exposure and into fresh air. Toxicity to skin and eyes should be flushed with copious amounts of water.

Treatment

Irritation of the respiratory tract should be treated with oxygen and cool mist to moisten the damaged mucosa. Bronchodilators can be used to resolve bronchospasm. With severe exposure, noncardiogenic pulmonary edema may occur. Early intubation should be considered due to edema caused by damage to the respiratory mucosa. Assessment of hydration may be required. The use of diuretics should be avoided.

Blood Agents

Blood agents are rapid acting chemical agents which can be lethal. They are usually seen in the form of a colorless gas or in the liquid state. The primary route of absorption is by inhalation. Blood agents poison the body inhibiting the enzyme cytochrome oxidase, thus interfering with cellular respiration.

Cyanide

Cyanide is widely utilized, manufactured, and transported in the United States. Used in printing, agriculture, photography, and in the manufacturing of paper and plastics, cyanide is often transported via rail in 30,000 gallon tanks which makes it a potential threat for terrorism.

Characteristics

Cyanide can be stored and transported in the liquid or solid state. As a liquid, cyanide vaporizes at about 73°F and 58°C, therefore, it will be in the gaseous form under most temperate conditions. It has been said that cyanide has a bitter almond odor, although it is undetected by 40% of the population. Large amounts of the chemical are needed to cause death.

Types of Cyanide

The three types of cyanide that may be encountered are hydrogen cyanide (AC) and cyanogen chloride (CK), which are the liquid forms, and cyanide salts (sodium, potassium, calcium), which are the solid forms. Hydrogen cyanide has no irritant properties. Cyanogen chloride is a pungent, heavier-than-air vapor which can cause irritation of the eyes, nose, and throat. Salts are most dangerous following ingestion because the onset of action is slower and more prolonged. Cyanide salts generate hydrogen cyanide gas on contact with a strong acid such as sulfuric acid.

Cyanide exists normally in human tissues and is usually metabolized in the liver and excreted in the urine. Toxicity occurs when the cyanide binds to iron in the mitochondria which prevents the cell from using oxygen. Without oxygen, cells begin to die, with the heart and brain cells affected initially.

Toxicity

Acute cyanide poisoning occurs after inhaling the agent, drinking solutions of cyanide or by skin contact with large amounts of liquid cyanide. After inhalation of a low concentration, the patient becomes anxious, begins to hyperventilate, may complain of dizziness and headache. Vomiting may also occur. A flushed or “cherry red” appearance to the skin may be seen, although this is uncommonly seen. Symptoms improve once the casualty is moved away from the source. Symptoms should not progress, but should improve once exposed to fresh air.

In contrast, after inhalation of a large amount of cyanide, approximately 15 seconds later, the victim becomes anxious and starts to hyperventilate. Thirty seconds after exposure, the victim may begin to have seizures. Three to five minutes following exposure, breathing ceases and in 6 to 10 minutes, asystole and death occurs. Initially there is absence of cyanosis and the patient may have normal sized or dilated pupils.

Patients will appear in respiratory distress but have a normal O₂ saturation. Metabolic acidosis, usually a lactic acidosis, will be present on ABG results due to the lack of oxygen to the tissues.

Cyanide toxicity can be measured by serum cyanide lab studies. However, there may be a delay of several hours in obtaining these studies.

Treatment

Victims must first be removed from the area of exposure. Prompt removal of clothing is necessary to prevent off-gassing. If patient has had a mild exposure, if conscious and breathing, give O₂, IV fluids, and observe. No antidotes are necessary.

Patients who have inhaled significant doses of cyanide must be rapidly treated with appropriate antidotes to prevent brain damage. Cyanide likes to bind to iron. When hemoglobin is converted to methemoglobin, cyanide will attach itself to methemoglobin and will leave the cell. Drugs such as amyl nitrite and sodium nitrite, which are found in the cyanide treatment kit, increase blood concentrations of methemoglobin and are antidotal. Patients are then given drugs such as sodium thiosulfate to complete the detoxification process.

Pasadena Cyanide Antidote Kit

This kit (formerly known as the Lily Cyanide Kit) contains amyl nitrite, sodium nitrite, and sodium thiosulfate.

Amyl nitrite is available in perles which are broken and placed in a gauze bandage and inhaled for 15 seconds, then taken away for 15 seconds. Amyl nitrite can also be placed in a bag mask device for those patients who are not breathing. Another ampule should be added every few minutes and should be used only until an IV is established and IV drugs available. This is the initial step in antidote therapy. Amyl nitrite will cause orthostatic hypotension. However, if the patient can stand and is breathing on his own, he or she does not need the antidote.

Sodium nitrite is a strong methemoglobin former that is available for IV use as a dose of 300 mg per 10 cc. This dose is injected over 5 minutes and can also cause orthostatic hypotension. Normal saline infusion and supine posture can help to correct hypotension. The pediatric dosage is 0.2 to 0.3 mg/kg or 6 to 9 cc/kg of the 3% solution, not to exceed 10 cc. However, if the patient can stand, they do not need sodium nitrite.

Sodium thiosulfate helps with detoxification by changing cyanide to a form that can be excreted by the kidneys. It is administered as a 50 cc ampule (12.5 gms), given IV over 5 minutes. For children, use 0.4 mg/kg or 1/65 cc/kg of the 25% solution.

Riot Control Agents

Riot control agents are a group of aerosol-dispersed chemicals that produce eye, nose, mouth, skin, and respiratory tract irritation. These agents are considered effective weapons for police officers and many of the civilian population as well, as they can disable an assailant. Riot control agents have also been used as a form of harassment weapon in many documented criminal cases. Riot control agents include:

- CN (Mace®)
- CS (tear gas)
- OC (oleoresin capsicum or pepper spray)
- DM (Adamsite - irritating and vomiting agent)

The deleterious effect of these agents usually lasts about 30 minutes after exposure. Because of this, most people will not seek medical care. Less than 1% will need care from a physician. Although not designed to produce death, fatalities have been associated with the use of these agents. Generally, the fatalities were the result of accidental death caused by panic during evacuations from areas in which the agents were used.

Characteristics

Riot control agents are generally solids, often dispersed in a liquid spray via grenades, bombs, and hand-held aerosol spray devices. In the past, use of CN (the active ingredient in Mace®) has caused several deaths from pulmonary injury. CS (tear gas) has proven to be less toxic. Capsicum, or pepper spray, is derived from the oleoresin capsicum in certain peppers and is most often seen as an aerosol spray carried by much of the civilian population. It is also used as an over-the-counter topical pain medication.

Eye Injury

Tearing, eye redness, and irritation occur with exposure to riot control agents. Blepharospasm, or spasm of the muscle that causes eyelid closure, causes very transient “blindness” due to the closed eyelids. Vision, however, is not impaired once the eyes are opened.

Possible complications could arise from impacted particles becoming embedded in the eyes. Contact lenses should be removed. Irrigation of the eyes with copious amounts of water or saline should be done. Utilization of a slit lamp for examination should follow to make certain that all solid particle foreign bodies are removed. Follow up with an ophthalmologist is recommended.

Airway Injury

Upper airway effects are usually seen as nasal discharge, sneezing, and burning. If the lower airways are affected, complaints of coughing, shortness of breath, and chest tightness may be seen. Bronchospasm and wheezing can occur for hours after the exposure, especially with those patients who have a history of pulmonary disease. Wheezing should be treated with bronchodilators or steroids if standard bronchodilators fail. Oxygen therapy should be administered if indicated. Most symptoms should be maximal within an hour or two.

Skin Injury

Most skin exposures require little more than reassurance. With prolonged pain, burning, or redness, decontaminate with soap and water or a solution containing a carbonate and / or bicarbonate. **Do NOT** use bleach. After exposure to large amounts of CS and CN, the onset of a more severe dermatitis with erythema and blisters may be delayed for 4 to 6 hours after exposure. These more severe effects occur under high temperature conditions with high humidity and large amounts of agent contacting the skin. These types of injuries should be managed with frequent irrigation and soothing ointments or creams.

Anxiety Induced Effects

Effects such as tachycardia, hypertension, and possible mild hypoxia may occur due to anxiety. A calming reassurance should be given to these patients.

Other Chemical Agents

Industrial chemicals are transported on major highways and railways throughout the United States everyday. These same chemicals are stored and used in industrial applications in businesses throughout the United States everyday as well. Although these chemicals are not known to have been weaponized as of yet, we feel that there is a potential use of these chemicals as possible terrorist agents. Many terrorists have the ability to easily obtain information about the transportation and storage of these chemicals, possibly making them viable targets for use in a terrorist attack.

Because there are so many available chemicals that could be potential targets, and because this book is not intended to be a Hazmat course, we are not going to identify individual chemicals. There are numerous Hazmat courses available and we suggest that everyone involved in Emergency Response should take a course of some type to become more familiar with these hazards. What we would like to do in this section, is give you a broad overview of the categories and refer you to resources, such as the North American Emergency Response Guidebook, the Material Safety Data Sheets (MSDS) for specific chemicals, Poison Control Centers or other Poison Indexes, etc. for specific actions to be taken for individual chemicals.

Irritant Gases

Irritant gases are classified by their solubility in water. By determining this solubility, you will be able to predict and effectively treat patients who present from such an exposure. These classifications are as followed:

- Highly water-soluble
- Moderately water-soluble
- Slightly water-soluble

Highly water-soluble irritant gases primarily affect the mucous membranes of the eyes, nose, and throat. Because these mucous membranes have copious moisture, the irritant gases dissolve very easily. Patients exposed to such irritant gases may have tearing and irritation of the eyes, rhinitis, sore throat and coughing.

Initial treatment for persons exposed to irritant gases is evacuation to fresh air. Depending on the duration of exposure and the concentration level of the agent, fresh air may be all that is necessary. However, patients should be observed for the need of oxygen and possibly bronchodilator treatments should they become necessary for treatment of bronchospasm. Irrigation of the eyes with copious amounts of water may also be necessary.

Examples of highly water-soluble irritant gases include formaldehyde, ammonia, acrolein, hydrogen chloride, and sulfur dioxide.

Moderately water-soluble irritant gases cause a slightly lesser degree of damage to the eyes and upper airway structures than a highly water-soluble irritant gas. But, because it is not as soluble in the upper airway moisture, these irritant gases reach down into the lower respiratory system affecting the tracheobronchial tree and the alveolar-capillary membrane. Persons exposed to moderately water-soluble irritant gases may also have tearing and irritation of the eyes, rhinitis, sore throat, and coughing.

Initial treatment for persons exposed to moderately water-soluble irritant gases is the same for highly water-soluble irritant gases. Removal of the person from the environment to a place of fresh air should always be the first step. Ventilation with 100% oxygen and bronchodilators may also be necessary. Since moderately water-soluble irritant gases can also effect the lower respiratory system, patients may exhibit signs and symptoms of impaired oxygen exchange caused by alveolar collapse, atelectasis, and noncardiogenic pulmonary edema. Depending upon the duration of exposure and the concentration level of the moderately water-soluble irritant gas, these symptoms may not be seen for up to 24 hours following exposure.

An example of a moderately water-soluble irritant gas would be chlorine.

Slightly water-soluble irritant gases are so much less irritating to the upper airways because they are not affected by upper airway moisture. Persons being exposed may not even notice any irritation to their upper respiratory systems, therefore remaining in an unsafe environment for longer periods of time. Slightly water-soluble irritant gases primarily effect the lower respiratory system causing damage to the alveolar-capillary membrane. Depending upon the duration of exposure and the concentration level of the slightly water-soluble irritant gas, these symptoms may not be exhibited for up to 24 hours following exposure.

Initial treatment of victims exposed to slightly water-soluble irritant gases is always the same- evacuate to fresh air. Upper airway symptoms and eye irritation will most likely not be seen. Lower respiratory damage may be exhibited within 24 hours of exposure to such agents. These systems most likely will be associated with hypoxemia as alveolar collapse and pulmonary edema occur.

Examples of slightly water-soluble irritant gases are nitrogen dioxide and phosgene.

Irritant gases are not systemically absorbed with inhalation exposures, although serious or even fatal systemic effects can occur. Because the respiratory system is primarily affected resulting in decreased oxygen delivery to vital organs, hypoxemia may occur resulting in myocardial and/or cerebral ischemia or infarction.

Organophosphate and Carbamate Pesticides

Organophosphate and carbamate pesticides are used in agriculture, structural insect control, and for home and garden use. These pesticides can enter the body by inhalation as dusts or mists, through the skin and mucous membranes, and by ingestion. Once these chemicals have entered the body, their mechanism of action is to deactivate acetylcholinesterase, thereby allowing the accumulation of acetylcholine. With this accumulation of acetylcholine, excessive stimulation of the muscarinic and nicotinic sites of the peripheral and central nervous systems occurs. Patients who present with an organophosphate or carbamate poisoning will present with the same signs and symptoms of nerve agent poisoning.

Muscarinic signs and symptoms can be remembered as **SLUDGE**.

- Salivation
- Lacrimation
- Urination
- Defecation
- Gastroenteritis
- Emesis

Nicotinic signs and symptoms can be remembered as the days of the week.

- Miosis
- Twitching
- Weakness
- Heartblock/ventricular arrhythmias
- Flaccid paralysis

Treatment for these patients consists of the use of Atropine, Praladoxime, and Valium to alleviate symptoms induced by the accumulation of acetylcholine. Refer back in this manual to the treatment of nerve agents for a more detailed treatment modality.

Corrosives and Solvents

Acids

An acid is defined as a substance that dissolves and ionizes in water to produce a pH that is less than 7. Inhalation of gases, vapors, or mists of acids can cause irritation and burns of the airway. The person may have coughing, burning, and difficulty breathing due to possible bronchospasm, laryngospasm, and edema of the upper and lower airway. If hypoxemia results, the cardiovascular and nervous systems can be indirectly affected. Patients will initially be tachycardic and tachydysrhythmias may follow. Agitation and anxiety leading to confusion and a decreased level of consciousness may occur. Eventually, if hypoxemia is not corrected, seizures followed by coma and death may ensue.

As with any respiratory exposure, the person should be removed from the environment to an area of fresh air. For persons exposed to gases only, consider removing their clothing that may have trapped or absorbed vapors. Delivery of 100% oxygen and ventilatory support may be necessary.

Acids are considered contact toxicants because they damage the biological surfaces in which they come in contact with. When an acid has contact with the skin, a pathologic change called coagulative necrosis occurs. Coagulative refers to tissue that forms a coagulum, a thick and somewhat hardened scab-like surface. Necrosis refers to death of the tissues. This buildup of dead tissues prevents the acid from further penetrating layers of skin. The extent of this local effect depends upon the concentration of the agent, the duration of contact, and the condition of the skin. Generally, injuries are not systemic, usually only limited to the site of contact.

For liquid exposures, removal of all clothing and jewelry is needed to prevent further contact of acids with skin surfaces. Decontamination of the skin should be accomplished with copious amounts of water and / or soap. Special attention should be paid to skin folds, the axillae, the genital area, and the feet.

Ingestion of acids causes burns to the gastrointestinal tract. Abdominal pain with nausea and vomiting of bloody stomach contents may follow. GI perforation can occur.

Examples of acids are acetic acid, hydrochloric acid, phosphoric acid, and sulfuric acid.

Bases

A base is defined as a substance that dissolves and ionizes in water to produce an alkaline solution that has a pH greater than 7.

Since alkalis are all highly water-soluble, inhalation of dusts or mists causes irritation and inflammation of the upper airways. Patients will present with burning of the eyes, nose, and throat. Rhinitis, coughing, and upper airway edema may be evident. Depending on the amount of the exposure, bronchospasm and laryngospasm may occur with noticeable wheezing. If respiratory problems continue and the patient becomes hypoxic, involvement of the cardiovascular and central nervous systems will follow in the same ways as those patients exposed to inhalation of acidic agents.

Exposed persons must be removed from the area and taken to fresh air. 100% oxygen and ventilatory support may be necessary.

Bases cause saponification, or soap production, to the fat of the skin. Saponification results in liquefaction necrosis of the skin surfaces which makes the skin look and feel slippery and soapy. This liquefaction allows deep penetration of the chemicals and causes deep chemical burns. The severity of the burns depends on the concentration of the base and the length of the skin's exposure to the base. The patient will complain of pain at the site of the burn. If the eyes are involved in the exposure, pain and altered vision usually occurs. Base burns to the eyes can result in blindness.

For all liquid or solid exposures, ensure that clothing and jewelry is removed. The patient should be decontaminated using copious amounts of water and / or soap. If eye exposure has occurred, irrigation of eyes should be initiated with water or normal saline. Irrigation can be made easier with the use of ophthalmic local anesthetics and use of a Morgan lens. Irrigation should continue for at least 20 minutes. The best endpoint for irrigation is restoration of the conjunctival sac to a pH of 7.

Ingestion of bases causes chemical burns to the gastrointestinal tract much worse than acids. Abdominal pain, nausea and vomiting of bloody stomach contents may occur. Severe injury of the oropharyngeal tissues may result in drooling, difficulty swallowing and breathing. Esophageal and lower gastrointestinal tract perforation can also occur.

Examples of bases include ammonium hydroxide, potassium hydroxide, and sodium hydroxide.

Ammonia

Ammonia is widely used industrially in the U.S. with over 500,000 workers potentially exposed annually. It is often used as an agricultural fertilizer and in the manufacturing of explosives, dyes, and plastics.

Ammonia is rapidly absorbed by mucosal surfaces and causes damage to the eyes, oral cavity, throat, and lungs. When mixed with water, it forms a corrosive agent, ammonium hydroxide, which causes considerable damage in the form of liquefaction necrosis. Due to its high water solubility, it penetrates tissues of the upper airway rapidly.

Characteristics

Ammonia is a colorless, highly water-soluble, alkaline gas that has a pungent odor. Household ammonia has a pH < 12 and causes limited damage. Anhydrous ammonia, which is an industrial chemical, has a pH > 12 and causes severe damage.

Eye Injury

Initially, ammonia causes burning, tearing, and severe pain to the eyes. Since it has a tremendous capacity to penetrate the eye, corneal opacification and lens damage leading to cataract formation usually occurs.

Airway Injury

Mild exposure causes cough, shortness of breath, chest tightness, wheezing, and laryngitis. Higher exposures can cause hypoxia, chemical pneumonia (pneumonitis), and hemorrhage. This will gradually improve over 72 hours. If the patient survives the first 24 hours, recovery is probable. Often times, higher exposures result in a non-cardiogenic pulmonary edema. Because of laryngeal swelling, early intubation should be considered to protect the airway.

Skin Injury

Pain, blister formation, and possibly deep burns similar to frostbite can occur.

Gastrointestinal Effects

If ammonia is ingested, severe mouth pain, cough, abdominal pain, nausea, and vomiting are likely. Severe edema of the lips and mouth is commonly seen. The patient should be observed closely to make certain that laryngeal irritation does not cause airway obstruction. Esophageal stricture and perforation is common.

Decontamination

After the patient has been removed from the area of exposure, decontamination should be started immediately. Remove all clothing and jewelry, and wash with soap and large amounts of water. The eyes should be irrigated continuously with water. A Morgan-lens device and topical analgesics will enable continuous eye irrigation therapy.

Oxidizers

Oxidizers have the chemical ability to oxidize other materials and are found among diverse chemicals with different structures, such as gases, inorganic solids and liquids, and others. Oxidizers affect the body much in the same way as acids and bases. Upper airway irritation and burns occur with inhalation. Lower airways are affected depending on the concentration of the oxidizer, and the length of exposure. Skin contact causes corrosion or chemical burns of the skin. Ingestion of oxidizers can cause gastrointestinal burn followed by abdominal pain, nausea and vomiting of bloody stomach contents.

Decontamination

Decontamination procedures include removing all clothing and jewelry and washing of skin with soap and large amounts of water. Eyes should be irrigated continuously with water.

White Phosphorus

White phosphorus, when exposed to atmospheric oxygen, will spontaneously explode. Therefore, persons exposed to white phosphorus will present with burns and may also have further injuries associated with an explosion.

White phosphorus is very corrosive to body tissues. Inhalation of white phosphorus powder would be very unlikely, because of its explosive properties. However, inhalation of the byproducts of combustion would be more likely and would cause irritation and burning to the upper airways. Deeper airway injury would include symptoms of wheezing and decreased air movement, possibly resulting in a non-cardiogenic pulmonary edema.

Contact of white phosphorus with skin surfaces causes very painful burns. Eye injuries associated with white phosphorus include blindness. As well, ingestion of white phosphorus causes severe burns to the gastrointestinal tract, nausea, vomiting, and smoky diarrhea stools.

With inhalation and tissue contact of white phosphorus, systemic absorption does occur resulting in hypovolemia, hypoxemia, and hypocalcemia. Conduction disturbances, dysrhythmias, and decreased cardiac output may follow.

Decontamination

Submerging areas of burned skin under water will stop the burning process associated with white phosphorus. Any imbedded particles of white phosphorus in skin tissues should be removed while under water and should be stored underwater to prevent further explosions. Thorough washing of skin surfaces and irrigation of eyes should be accomplished quickly.

Hydrocarbons

Hydrocarbons can be found in several types including aliphatic hydrocarbons, aromatic hydrocarbons, and halogenated hydrocarbons. Aliphatic hydrocarbons can be in a gaseous, liquid or solid state. The main source of gaseous aliphatic hydrocarbons is natural gas. The two primary sources of liquid and solid aliphatic hydrocarbons come from petroleum and distillation of pine trees. Examples of these include gasoline, mineral spirits, kerosene, turpentine, etc. Examples of aromatic hydrocarbons include benzene, toluene, and aniline. Many halogenated hydrocarbons serve as refrigerants and are collectively called by the trade name Freon. When all binding sites of halogenated hydrocarbons are bound with halides, these hydrocarbons are nonflammable. These types of halogenated hydrocarbons are used as inhalation anesthetics such as chloroform.

Hydrocarbons are flammable materials posing not only a threat to the body via inhalation, absorption, and ingestion, but also by threat of fire and explosion. With inhalation, all volatile hydrocarbons serve as simple asphyxiants, displacing oxygen from the ambient air causing less oxygen to enter the lungs with each inhalation. Enclosure in confined spaces where hydrocarbons are present increases this risk. Central Nervous System (CNS) effects include a decreased level of consciousness and narcosis, resulting in coma and death. Hydrocarbons also sensitize the heart to endogenous catecholamines and this can lower the threshold for ventricular fibrillation.

Upon contact with skin and mucous membrane surfaces, hydrocarbons can penetrate through the skin because they are lipid (fat) soluble solvents, and the skin is mostly fat. This penetration of bodily tissues can result in skin and mucous membrane irritation, defatting dermatitis, and chemical burns. Absorption of hydrocarbons can also occur via ingestion. If ingested, irritation and burning of the gastrointestinal tract can cause nausea, vomiting, and diarrhea. An increased risk with ingestion is aspiration of the hydrocarbon resulting in an aspiration pneumonitis.

Decontamination

With inhalational exposures, remove the victim from the source to an open air environment. Ensure adequate ventilation. Administer oxygen as necessary. Clothing should be removed to prevent off-gassing.

If skin or mucous membrane contact is made with liquid or solid hydrocarbons, clothing and jewelry should be removed and the victim should be decontaminated with large amounts of water or washed thoroughly with soap and water. Eyes should be irrigated continuously with copious amounts of water for at least 20 minutes.

Hydrofluoric Acid and Fluorides

Fluorides can be found in solid, liquid, or gaseous states and are especially important in industries such as petroleum refining, semiconductor production , and aluminum production.

Inhalation of gas, mists or dusts can cause irritation and burns to the upper airways. Deposition of the chemical further down into the respiratory tract will determine further inflammatory symptoms, such as alveolar-capillary membrane involvement resulting in hypoxemia. Depending upon the solubility and chemical reactivity of the agent, the onset of symptoms may be rapid or delayed for 12 - 24 hours.

With skin contact, fluorides cause severe burns to the skin. Severity of injury to the skin depends upon the concentration of the acid, area of skin involved and the length of exposure. With more dilute hydrofluoric acid solutions, burn formation may be delayed for 6 - 24 hours after exposure. With intermediate concentration solutions, burns may be delayed for .5 - 6 hours, and with high concentration solutions, immediate burns will be seen. The pain associated with these burns is often severe and tend to be out of proportion to physical findings observed at the burn site. This may in part be due to the later onset of obvious burn formation from dilute and intermediate concentration solutions.

With such a severe burn, these acids can penetrate to the bone and enter into the circulatory system. This systemic involvement results in hypocalcemia , hypomagnesemia, and hyperkalemia. Because of this electrolyte imbalance, skeletal muscle twitching and tetany, myocardial irritability, decreased cardiac output, and vasospasm would most likely occur.

Mass Casualty Incident Planning

No two disasters are ever exactly alike. They may be similar in type, damage caused, relief efforts that are required, etc., but still each disaster is unique in its own respect. However, there are several important aspects which will be common to most disasters.

- Generally, disasters will occur with little, or no, advance warning.
- Disasters contain the threat of injury or death to people.
- Disasters contain the threat of destruction of property.
- Disasters create an element of panic, fear, or confusion among persons effected.
- During disasters, the people affected will turn to individuals in authority for help.

Since most disaster situations will occur without warning it is important to anticipate the possible occurrence of these situations in advance. Pre-planning is the single most effective way to minimize the negative effects of disaster situations. Advance planning is essential for an effective emergency response effort, as well as, post incident recovery activities. The process of emergency management occurs before, during, and after a disaster. This emergency management process is divided into four phases:

- **Preparedness**

This phase of emergency management will involve all of the activities which prepare us to handle a disaster when it occurs. Developing the disaster response plan, purchasing and storing equipment for emergency use, forming crisis management teams, training personnel, conducting emergency preparedness drills, etc., are all preparedness activities. All preparedness planning must be produced in written form, identify the disasters to be addressed, and establish the objectives and goals of the plan.

- **Response**

This is the phase of emergency management that includes all emergency response activities when a disaster occurs. Responding to a disaster occurs on many different levels and may include assistance from city, county, state, or federal agencies. Typical community response activities include such things as evacuations, opening relief shelters, providing temporary medical treatment facilities for injured victims, distributing relief supplies, etc. One aspect that is consistent in all disasters is that injured persons must, and will, seek medical treatment. During disasters resulting from incidents of terrorism, the potential for extensive damage to property, and injury or death to people, is enormous. Because of this reality, hospitals should develop detailed plans for the medical management of these types of disasters.

- **Recovery**

Once the disaster is over, we move into the recovery phase of emergency management. Recovery is all the activities that are necessary to recover from the disaster. The goal of recovery operations is to quickly rebuild what has been damaged or destroyed by the disaster, reestablishing normal community needs. These activities could include repairing damaged buildings, reestablishing utilities, clean-up activities, etc.

- **Mitigation**

Mitigation is an ongoing phase of emergency management in which the overall incident response operation is studied and evaluated. Additional planning or revisions in existing plans are then conducted to make disaster preparedness, response, and recovery operations more effective the next time a disaster occurs. In addition to the study and evaluation of incidents effecting our community, we must all study those disasters which occur to others. By doing so, we can learn a wealth of information regarding planning and response activities that work effectively, as well as, mistakes made by these other communities. This information can then be utilized to revise and make improvements to our existing emergency planning.

The purpose of this book is to focus on disasters related to acts of Biological and Chemical Terrorism. Medical professionals will play a vital role in a disaster stemming from the intentional use of a Biological or Chemical warfare agent. Knowing this, it is important for all medical professionals, especially nurses and physicians, to have advance awareness and understanding of the nature and effects of these types of disasters. This advance awareness must include, at a minimum, such issues as; 1) mass casualty triage and decontamination, 2) proper uses of chemical protection equipment, 3) biological and chemical agent characteristics, effects, and treatment protocols, 5) medication supplies available, 6) general operational safety & security, 7) adequate patient treatment areas, 8) medical staff deployment. Preparing for this type of disaster in advance is an important aspect in the success of a comprehensive hospital Mass Casualty Incident plan.

When was the last time you, as a hospital employee, were involved in a disaster drill? Was this drill taken seriously by the employees or was it considered just another headache to have to deal with? In reality, most disaster plans fail due to lack of motivation. Disaster drills are infrequently given appropriate emphasis because disasters are commonly seen as low probability events. Therefore, most education and training is devoted towards caring for the everyday patient routine. Another reason why disaster planning may fail is because of the lack of administrative support. If administration does not emphasize the importance of such planning, why should employees feel that it is an important issue.

Over the past few years we have seen hospitals, who were involved in disaster situations, come to realize the importance of disaster planning. Myths such as disaster planning requires large mobilization of resources and most medical care of disaster victims is provided by pre-hospital personnel have been dispelled. When in reality, disaster planning can be accomplished with the establishment of an Incident Command System (ICS) and standard operating procedures (SOP's).

Whether a disaster confronted be of man-made or natural circumstances, a unified, standardized approach will help bring order to a chaotic environment.

Emergency Department Planning

One of the biggest challenges in a disaster is the managing of resources. Typically, there is not a shortage of available medical resources. Most problems encountered in disaster response occur due to failure in the coordination and appropriate utilization of these resources. Integration of other hospital departments into the Emergency Department planning will provide for direct service from these departments. But what about other needs that can not be met by these departments? A properly structured ICS system can manage hospital resources effectively and can provide a means for the Emergency Department to obtain needed staffing, equipment, and supplies that may otherwise be out of reach.

When a “real” disaster occurs, many hospital employees may show up at the Emergency Department offering their assistance. Many of these personnel may not be familiar with the policies, procedures and operations of the Emergency Department, and many may have never participated in previous disaster drills. The end result is a loss of control in the Emergency Department over the disaster event. With this in mind, proper assessment of staff responsibilities will be critical and communicating those needs to the ICS director will be of the utmost importance. The assignment of staff from other departments must be managed effectively to prevent the breakdown in patient care. Tasking personnel specifically trained in the Emergency Department’s response plan will ensure that patients are received, decontaminated as appropriate, and initial treatment begun prior to their entering the Emergency Department. This will alleviate the burden of this responsibility from the Emergency Department’s Nurse Manager / Charge Nurse and will allow her / him to concentrate on further issues such as the coordination and appropriate utilization of staff, coordination with other units for patient placement, maintaining direct communications with the ICS director, and direction of the unit activities.

Integration Of Support Departments

The hospital Emergency Department will primarily be responsible for operational management of a Mass Casualty Incident (MCI) event. However, the Emergency Department could not operate effectively without the support from other departments within the hospital system. The basic function of the Emergency Department is to provide triage, decontamination, treatment, and other related functions during a Mass Casualty Incident (MCI) involving the use of a Chemical, Biological, Radiological or Nuclear agent. While the Emergency Department’s role during an MCI is very specific, the MCI also affects other departments within the hospital system. These other hospital departments also have specific roles to play in support of the MCI operation. Emergency Departments must determine how other departments within the hospital system support an MCI operation in the ED, and integrate this planning into its own.

While different hospitals may have a slightly different name for various departments, we have identified several departments which may be called upon to provide specific support functions to the Emergency Department during an MCI. They include:

- Security Department
- Engineering / Maintenance Department
- Linen Services
- Housekeeping Department
- Dietary Department
- Morgue Department
- Administration
- Patient Transportation
- Social Services

Security

Security will be an issue of great importance during an MCI operation. Situations requiring crowd control, traffic control, building protection, etc. should be anticipated in the aftermath of a terrorist event. The hospital security team will be responsible for several key functions during the MCI operation. The Hospital Administration, along with the Emergency Department must identify the security aspects which are required to assist in its operation and coordinate with the Security Department to have these requirements addressed.

The following are key issues of consideration:

- Scene security around the triage and decontamination areas, including access control. The issue of security for the triage and decontamination areas can not be overlooked during the planning or deployment stages of an effective MCI operation. It will be necessary to establish operational HOT, WARM, and COLD ZONES within areas of patient triage and decontamination. The operational integrity of these ZONES must be maintained at all times to insure that the safety of medical personnel, patients, responders, and visitors remains consistent. Maintaining security of HOT, WARM, and COLD zones should include the application of boundary markers such as barricades, caution tape, etc. along with warning signs to define HOT LINES, WARM LINES, and COLD LINES. In addition, monitoring personnel may be required to insure that these operational ZONES are not violated in such a manner as to allow contaminated persons to accidentally enter a COLD ZONE or non-contaminated persons to enter a HOT ZONE.
- Access control procedures to the Emergency Department treatment areas must be established to insure that contaminated persons do not enter prior to proper decontamination. Interior treatment areas within the Emergency Department will be an established COLD ZONE and must remain as such during the entire MCI operation.
- Access Control procedures must be established at all other hospital entry points to insure that contaminated incident casualties do not enter the facility prior to triage and proper decontamination.
- Traffic control of Emergency Vehicles entering and departing the patient triage receiving area must be maintained in order to insure that an effective patient delivery operation occurs.
- Traffic control of all other vehicles entering or departing the Emergency Department receiving and parking areas, including the separation of patients arriving from the MCI scene in private vehicles from other non-MCI related patients. Procedures should be established for the isolation and testing of vehicles transporting self-referring patients from the MCI site. All non-emergency vehicles delivering contaminated patients to the hospital should be viewed as highly suspect and considered contaminated until testing can be conducted.
- Crowd control of personnel, visitors, spectators, etc. around the triage area, decontamination area, vehicle entrances, visitor waiting rooms, parking areas, etc.
- Determination as to levels of Personal Protection Equipment (PPE) required for security personnel working during the operation must be assessed.
- Identification of all necessary equipment required to assist security personnel with scene security, crowd control, traffic direction, etc. must be established. This should include all necessary personal protection equipment and clothing (PPE), traffic barricades, public address equipment, operational communications, flashlights, safety vests, protective lighting.
- The Security Department should be prepared to quickly elicit support from non-security personnel if their team becomes taxed. This can be accomplished by training personnel from departments not heavily involved in the incident response to provide less demanding security related functions such as traffic control.

Food / Dietary Services

It should be anticipated that terrorist acts which create an MCI event will result in large numbers of casualties arriving at the hospital. It should also be anticipated that in addition to this increase in patients, there will be significant increases in the numbers of other people arriving at the facility such as visitors, family members, additional hospital employees, emergency services personnel, news media, government officials, etc. Due to this situation, consideration should be given to the availability of food and beverages for these people during the operational phase of the MCI event. This is especially important if the MCI turns into a lengthy event.

A full scale cafeteria operation may not be necessary to supply this service if emphasis is placed on easily prepared and transportable food and drink items. Since this service will most likely be provided as a courtesy, consideration must be given to limiting cost, work load on dietary personnel, food spoilage and waste disposal. The following are points to consider when coordinating the food service support element to the disaster plan:

- The operational hours of the dietary department must be considered. Is the hospital's cafeteria open 24 hours a day? Will personnel need to be called into work?
- Available food stocks must be considered. Can additional food supplies be obtained? What will be the source of the additional food supply?
- Emphasis should be placed on providing foods that are easily prepared and transportable, such as deli style sandwiches, pre-packaged snacks, fruits, etc. Beverages could include coffee, soda and fruit drinks preferably in cans or plastic containers (to limit possible incidents of glass breakage).
- Catering services may be an option to support the hospital's Food Services department.
- All planning must be developed in writing and food service personnel briefed on the requirements of the disaster plan.

Linen Services

During an MCI involving a decontamination operation, Linen Services will play a vital role in the support of the Emergency Department. Decontamination operations will require an extensive amount of towels and patient gowns. Large numbers of bed linens will also be required to support the emergency department's patient treatment operation. A large stock of towels, bed linens and patient gowns should be pre-positioned in the emergency department for immediate use in the event of an MCI requiring a decontamination operation. This pre-positioned supply should be adequate to support a decontamination operation for at least 50 patients initially, with a plan to continuously re-supply the decontamination operation. Coordination between Linen Services and the Emergency Department will be essential to insure that an adequate supply of linens are always available. Consideration should be given to developing plans for the emergency acquisition of linens from other medical departments within the hospital if necessary. Personnel working in Linen Services must also be adequately trained in procedures for laundering contaminated hospital linens and clothing.

Engineering / Maintenance Department

Maintenance personnel could be called upon to supply a wide variety of support services during a disaster operation. The extent to which these personnel provide support will greatly depend upon the requirements of the disaster operation plan. Maintenance personnel may be required to erect portable decontamination showers, set up temporary shelters such as tents, supply portable power generators, portable lighting, supply barricades for traffic control, etc.. In addition, these personnel may also be responsible for the clean up after the operation has ended. Standard hazmat protocols should be reviewed and upgraded to include Biological and Chemical weapon agents if necessary. Planning must identify all equipment, procedures, and services required from maintenance personnel and a coordination of plans be established with the Emergency Department.

Patient Transportation Services

Mass Casualty Incidents (MCI) which produce large numbers of patients will require additional patient transportation consideration. Are there enough wheelchairs or stretchers to facilitate the operation? Who will transport patients from the Emergency Department to definitive care units? How will these patients be transported? Will transportation equipment require decontamination between uses? These are only a few questions which must be answered in order to establish an effective disaster plan. Review current procedures for patient transport to identify areas which will require additional planning and coordination.

Morgue Department

In Weapon of Mass Destruction incidents, the issue of processing, decontaminating, and storing of the deceased will be one of great importance and must be planned for in advance. Taking into consideration the very nature of Weapons of Mass Destruction, one should assume that if such a weapon was used, mortality rates within the community would rise dramatically. This increase in citizen mortality may occur quickly if a Chemical Weapon agent was used in the attack, or over a period of several days in the case of a Biological Weapon attack. This increase in civilian fatalities may quickly over tax existing hospital or community morgue facilities. Plans must be developed to insure that adequate mortuary services are available to properly handle the deceased. Local government should coordinate efforts with all area hospitals, funeral homes, county health department, Federal response resources, etc. to insure that this need is met. In situations where existing morgue facilities have reached capacity levels, it may be necessary to utilize refrigerated trucks as temporary storage for incident fatalities. If refrigerated trucks are utilized in the mortuary service operation, consideration must be given to staging locations and security of the vehicles.

Another issue of importance is the proper decontamination of incident fatalities. Individuals that have died in the incident must be decontaminated in the same manner as other incident casualties. Plans regarding the decontamination of incident fatalities should address the location of this type of operation, who will provide the service, equipment requirements, records keeping, personal belongings inventory and storage. Personal belongings that can be salvaged and decontaminated should be processed for return to family members, if possible. Issues regarding the return of victim belongings to family members must be coordinated with government agencies conducting relief efforts prior to doing so. All operations involving deceased victims should be conducted with an underlying attitude of care and understanding. These individuals must be handled with dignity and respect at all times. Never forget that they are our families, friends, neighbors, and fellow citizens. In addition, mortuary operations must not be conducted within the purview of living incident casualties.

Housekeeping Department

In the everyday work environment, the housekeeping department is responsible for cleaning areas contaminated with known infectious processes. Policies and procedures are already in place for proper decontamination of equipment and structures. As well, procedures for preventative measures are in place to protect these employees from contracting disease and illness during these cleaning procedures.

With an event involving biological or chemical warfare, the cleaning of equipment and structures will be done in much the same way as cleaning for blood borne pathogens performed by the housekeeping department. Exceptions to this rule will be the need for increased personal protection equipment (PPE) in some instances, and any variances in cleaning materials and procedural time. The housekeeping department should be instructed on proper personal protection equipment that will be needed for cleaning areas contaminated with agents such as chemicals. As well, procedures for the proper cleaning of these areas should be pre-established and available for reference should it be necessary.

Administration

During a Mass Casualty Incident, Hospital Administration will typically function as the command center for the entire MCI operation. It is the job of Administration to consider all operational logistics in advance, as well as, provide support and leadership throughout the MCI operation. Risk management, legal issues, financial issues, staff deployment and scheduling, re-supply requirements, public relations, communications, safety & security are all just a few of the operational concerns that must be addressed in the MCI planning. A system of incident management, such as the Incident Command System (ICS) or a Crisis Management Team, must be established in order to conduct an effective, safe, and productive emergency response operation.

The standard incident management system used by most government agencies and emergency response organizations is the Incident Command System (ICS). The Incident Command System (ICS) is a simple management structure that is built around five major operational areas; incident command, logistics, planning, operations, and finance / administration. Each operational area has one individual that is in charge of the activities of that section and this individual reports directly to the Incident Commander, who is in charge of the entire operation. This form of simple management allows for an effective flow of information and operational resources. It also allows for multiple incident response efforts to be coordinated under one unified command activity, without sacrificing command and control of those individual response efforts. Hospitals should study the Incident Command System (ICS) and consider developing a crisis management system that resembles it. This will allow the hospital's response efforts to be easily coordinated with that of other emergency response organizations.

No matter what type of crisis management system is created, all operational planning must be structured in extensive detail and reduced to written format. This emergency operations plan must identify all aspects and protocols associated with the response effort and be written in easy to understand terminology. Once the MCI response plan has been created, it must be circulated to all departments and the training of staff members conducted. The MCI plan should not be considered static, and periodic review and updating of the plan should be conducted in order to mitigate new threats and include advances in response technologies.

Social Services

The hospital Social Services Department will play a vital role during MCI events. During any disaster, emotions can run high. Stress, fear, panic, confusion, anger, rage, paranoia, etc. are all common emotions felt by those who have been involved in a disaster situation. This holds true for incident victims, family members, and emergency response workers alike. Social Service professionals can assist greatly in the disaster relief effort by providing victims, family members, and staff with information regarding emotional support and mental health needs. Social Service workers should be prepared to handle requests for pastoral services, victim services, emotional or stress counseling, etc. A list of organizations and professionals providing these types of services should be created for distribution during the crisis.

In addition, consideration should be given to the creation of fact sheets explaining the characteristics of individual chemical and biological agents. These fact sheets should list the agent, explain transmission data, decontamination procedures, etc. The benefit of such facts sheets is two fold. First, they are a good method of informing incident victims and families regarding the specific characteristics and treatments for an agent. Secondly, they serve as a simple way to answer questions that will no doubt be raised by victims and their families. Feelings of fear, panic, and uncertainty among incident casualties must be reduced, and information will greatly assist with achieving this goal.

A waiting area for family members of incident casualties should be established. This area should be located away from the patient receiving and decontamination areas, as well as the Emergency Department. The family waiting area should have access to telephones, coffee or other refreshments, television, etc. A hospital representative should be present to assist with coordinating family member's needs.

Communications

One area of both disaster planning and response activities which has always presented problems is the area of effective communications. When conducting your Mass Casualty Incident planning, consideration must be given to how response personnel will communicate with each other. This issue must not be overlooked if an efficient and safe response operation is the goal of your MCI planning.

During a disaster, dramatic changes in events can occur rapidly. Having up to the minute information regarding the status of the situation will be crucial for operational success. It is important to establish and maintain a system in which information can flow spontaneously in both a clear and easily understood manner, throughout the entire operation.

Command Communications

During large scale disasters, the hospital's Crisis Management Team (CMT) will most likely be activated. The Crisis Management Team (CMT) will function as the command and control element of the response operation. The CMT will be responsible for providing overall leadership, coordinating the efforts between hospital departments and outside agencies providing assistance, handling operational logistics, legal issues, disseminating information to the public, in addition to a wide range of other administrative duties. Because the CMT functions as the command element of the operation, information must flow to the CMT and from the CMT in a manner which is both quick and continuous. The Crisis Management Team (CMT) should operate from an established command center on site. This command center should be located away from the major operational aspects of the response effort. The command center must afford the CMT members an

environment of security and quiet in which to concentrate on critical decision making. Access control must be maintained for the command center at all times.

Since information is key to the decision making process, the command center should be equipped with multiple (multi-line) telephones, fax machines, handheld radio communications, access to both the Internet and the hospital's Intranet, television, copiers, writing supplies, etc. Each CMT member should be equipped with a personal pager, cellular telephone, and handheld radio. Information flowing into the command center must do so through an established procedure. The average size of a Crisis management Team (CMT) is between 5 and 10, with each member being responsible for a particular aspect of the operation. Operational aspects would include: command, logistics, operations, legal, information, public relations, finance, inter-agency liaison, or any other aspect important to an individual organization. Since a Crisis Management Team (CMT) is composed of such a limited number of people, restrictions must be placed on who can provide information to the command center. It should be obvious that if all persons involved in the response effort had the ability to contact the command center directly, the CMT would be overwhelmed in a short time. The standard procedure for information exchange should be: employees report to supervisors; supervisors report to department heads; department heads report to the CMT. This procedure should also work in reverse. All communications with the news media should be arranged through the CMT.

Operational Communications

Fulfilling the requirements for effective operational communications can be a difficult task at a minimum. Pre-planning will ensure that such an important aspect of Mass Casualty Incident (MCI) response will not be forgotten. Employees tasked with operational responsibilities must have the ability to communicate with each other, support departments, hospital management, and the public. The effectiveness of operational communications will depend upon an individual hospital's advance planning and available equipment resources. Two fundamental mediums for communications are the telephone and two-way radios. Telephones will be widely available in the workplace, however they are not very portable unless they are cellular. Two-way radios are ideal for portable communications, however, they are usually not present in sufficient numbers, if present at all. Advance planning should identify the proper communications equipment needed for all operational aspects of the Mass Casualty Incident (MCI) plan. Once equipment issues have been identified and addressed, procedures for an effective flow of information should then be established. Two operational areas in which communications will be crucial is Emergency Department services and Security.

The Emergency Department (ED) will provide the bulk of the direct patient services during the MCI operation. The ED will likely conduct the triage and decontamination operations, as well as initial patient treatment. During an MCI operation, the ED staff will usually be divided into these three working groups; triage staff, decontamination staff, and patient treatment staff. It will be critical that these three working groups be able to communicate with each other at all times. In addition, the ED staff must be able to communicate with support departments within the hospital. Two-way radios would allow for effective communications between ED staff members working their various assignments, especially triage and decon. Considering that triage and decontamination operations will generally occur outside the treatment areas within the ED, relaying information via two-way radio would be efficient. Emergency Department staff providing patient treatment inside the facility would have access to telephones and could relay request for support from staff working triage and decon. Staff members assigned to triage and decontamination operations must also have the ability to clearly communicate with arriving Emergency Services personnel and patients. The ability for triage and decon staff members to clearly communicate may be hampered by

Personal Protection Equipment (PPE) being worn. If persons arriving at the triage and decon areas can not clearly understand instructions being issued by ED staffers, due to PPE, than problems could arise. This reality must be considered and addressed in advance. Ways of countering the negative effects PPE may have on communications include utilizing megaphones and / or written instructions posted on signs.

Another area in which effective communications will be important is security. It should be obvious that all members of the hospital security team must be able to communicate with each other. Hospital security will be responsible for providing general protection of the facility, crowd control, traffic direction, access control, etc. If effective communication between security personnel is not maintained, the integrity of the entire MCI plan may be compromised. Communications between security personnel and Emergency Department must also be established and maintained at all times. Emergency Department staff operating in the triage and decontamination must also be able to communicate with the security personnel maintaining the scene control of these areas.

Integrating Local Emergency Medical Services (EMS)

Emergency Medical Services (EMS) can include full time city / county rescue services, volunteer rescue departments, or private ambulance services. Once your hospital's Mass Casualty Incident (MCI) planning has been completed, all local Emergency Medical Services (EMS) should be introduced to the plan. The goal is to develop understanding and coordination between the EMS services transporting casualties and the hospital receiving these casualties. Mass Casualty Incidents evolving from an act of terrorism are likely to be stressful and confusing, at both the incident site and the hospital. In order for the response operation to be as efficient and effective as possible, everyone involved should know the other's planning. This can be accomplished in two basic ways. EMS personnel should be invited to the hospital to review planning and survey the triage, ambulance receiving area, decontamination areas, etc. Or the Emergency Department could develop a presentation outlining the hospital's plan and deliver it to local EMS services. No matter which method is used to present this information, local EMS responders must have a clear understanding of the hospital's plans and procedures for the medical response to MCI's resulting from an act of terrorism.

Decontamination Procedures

Decontamination is defined as the reduction or removal of chemical or biological agents from skin and equipment surfaces so they no longer pose a medical threat or hazard. There are three types of decontamination that are of concern during a chemical or biological warfare attack. The first is casualty decontamination which refers to the decontamination of persons involved in such events. These people will need immediate decontamination at the scene or upon arrival to the Emergency Department. The second type of decontamination is personal decontamination which refers to decontamination of oneself prior to leaving the Hot Zone. The third type of decontamination is equipment and facility decontamination which refers to the decontamination of all equipment and structures, such as inside (permanent) decontamination sites. Each of these will be discussed in more detail later.

As Emergency Department personnel, it will be your responsibility to adequately decontaminate and treat victims involved in a Mass Casualty Incident (MCI) involving chemical and/or biological agents. Because of delays in setting up decontamination procedures at the scene of such an incident or because of general lack of awareness of decontamination availability at the scene, most victims perceive the hospital to be a safer and more secure environment and will preferentially triage themselves to the hospital. Previously studied disasters have shown that more than half of victims involved in a disaster, self refer to Emergency Departments for medical attention. These victims may show up at your hospital prior to any official notification that a disaster situation has occurred. Therefore, surveillance of such victims must always be employed by Security and Emergency Department personnel. Plans must be established beforehand to effectively manage a situation in which a contaminated victim(s) arrives and possibly enters the hospital. With such an incident, the victim(s) must be immediately isolated and measures taken to prevent further contamination of the facility and bystanders, including hospital employees. Direct contact with the victim(s) should be avoided until proper personal protective equipment (PPE) can be donned. Actions taken to render assistance to the victim(s) prior to donning PPE may jeopardize the lives of those healthcare workers, increasing the number of victims, and decreasing the number of available healthcare workers to provide assistance with further disaster relief operations. Therefore, policies and procedures must be in place to address these issues.

Decontamination Structures

Decontamination structures are those areas in which washing of patients and personnel will occur. There are two types of decontamination structures that can be used by a hospital; interior structures which are permanent and exterior structures which may be permanent or portable. Both types of decontamination structures are similar with respect to operational procedures and results achieved. Each structure has its own inherent benefits and challenges. Depending upon a hospital's unique setup and/or resources, an interior or exterior decontamination structure, or both, may be utilized. Which ever structure(s) will be operational at your facility, it must be accessible to both ambulatory and stretcher bound patients.

- **Interior structures**

Interior decontamination structures are usually built as part of the Emergency Department. These structures should have two separate entrance ways, one leading to the outside of the building and one leading into the Emergency Department. Again, this will depend upon each individual hospital. Interior decontamination structures must be equipped with negative ventilation equipment to prevent facility contamination. These

units must also have a water retaining tank to hold contaminated water and prevent it from entering the public sewer system. This contaminated water that has been collected must then be pumped out of the storage tanks and disposed of properly. Most interior decontamination structures are small and do not accommodate large numbers of people at one time, so decontamination of large numbers of casualties may be very time consuming. One benefit to having an interior decontamination facility may be the availability of hot water.

- **Exterior structures**

Exterior decontamination structures may be permanent outside structures built specifically for decontaminating large numbers of people quickly. These units may or may not be well equipped. Portable decontamination structures may range from a simple inflatable pool and a water hose to any of the wide variety of commercially available decontamination units. Which ever unit an individual hospital decides upon, all must adhere to certain guidelines. The setup of portable units must be placed in the ambulance bay or close to the Emergency Department entrance. Each unit must provide for the retaining and storing of contaminated run-off water, such as an inflatable pool with a pump system to draw contaminated water into reserve holding tanks or barrels. If inflatable pools are used, a configuration utilizing a six foot pool, inside a twelve foot pool, is effective for trapping run-off water during the decontamination procedure. The patient stands in the six foot pool during the decon procedure which retains the bulk of the run-off water. The twelve foot pool will catch water which splashes out of the six foot pool during the procedure. The water from both pools must be pumped out and stored for disposal later. Privacy issues for when patient's are undressing and showering must also be explored. Portable dividers or curtains can be erected for the purpose of patient privacy. One other drawback to having an exterior decontamination unit is that usually only cold water is available. This fact may cause the decontamination procedure to be even more uncomfortable for the patient. Understanding and reassurance should be afforded to the patient by staff members.

Designation and Zoning of Receiving Area

To carry out a successful triage and decon operation, zones must be established in which to receive contaminated victims, decontaminate them, and move them out and into the Emergency Department for further treatment and observation. The first zone to where contaminated victims enter is considered the Hot Zone. In the Hot Zone, concentrated levels of contamination from chemicals or possible biological agents arriving with victims, will be present. All contaminated victims will enter into the Hot Zone so as not to contaminate other surrounding areas. Victims will then undergo triage and decontamination procedures. Once decontaminated, victims will move into the Warm Zone where drying, dressing, and other minor first aid procedures will take place. Once this has been accomplished, the victims will move into the Cold Zones. The Cold Zones are considered anywhere there is not a potential threat of chemical or biological agent contamination. The designation of these zones are very important to ensure the safety of healthcare workers, visitors, and other patients. It must be noted that an object or person can advance from the Cold Zone to the Warm Zone to the Hot Zone, but once an object or person enters the Hot Zone, decontamination must occur before entering the Warm and Cold Zones. An example of this zoning may be: your ambulance bay, including a portable decontamination shower at the edge of the bay, would be designated as the Hot Zone. Victims would enter into the ambulance bay Hot Zone. A perimeter would then be established extending outward from the exit of the decontamination showers which would be designated as the Warm Zone. Areas extending beyond the Warm Zone perimeter would be considered Cold Zones.

- **Designation of the patient receiving area**

Hot, Warm, and Cold Zone perimeters must be decided upon in advance. This area must be accessible to incoming rescue vehicles and other vehicles which may be bringing persons from the disaster scene. It should not be placed in an area of normal pedestrian traffic entering and leaving the hospital. The triage area should be roped off or marked in some way to make people aware that they should not enter. A decision should be made as to who will be responsible for marking and identifying these areas. Security should also be able to secure the perimeter of the Hot and Warm Zones to prevent unintended people from entering.

- **Designation of portable decontamination site(s)**

Predetermination of who will be responsible for erecting portable decontamination equipment must be addressed. Portable decontamination stations must be setup in an area that is accessible to the Cold Zone, but also prevents patients from reentering the Hot Zone once they have been decontaminated.

- **Containment of contaminated water from decontamination site(s)**

Decontamination sites that are free standing and designed as part of the hospital Emergency Department should have a collection tank that prevents run-off water from entering the public sewer system. If this is not part of your decontamination room, or if a portable decontamination unit is used, consideration must be given to the collection, storage, and proper disposal of contaminated run-off water.

- **Predetermination of stretcher/wheelchair needs and their location**

Stretchers and wheelchairs will need to be accessible for use. Thought must be given as to the number of each that will be needed and where these will be located for immediate use. It must also be noted that once this equipment enters the Hot Zone, it can not be removed from the Hot Zone until it has been decontaminated.

- **Designation of personnel assigned to the patient receiving area**

Job positions should be assigned and named in advance. Job descriptions should be written for each position so that anyone filling a position would easily know their intended responsibilities. Arm bands or vests should be used to designate each position during an MCI event.

- **Patient flow**

Predetermination of patient flow must be addressed. Patient drop-off point must be established. It must be decided upon in advance as to whether victims that have been decontaminated at the scene will receive further decontamination at your facility prior to allowing entrance into your Emergency Department. If it is decided that previously decontaminated patients need no further decontamination procedures, these patients must not enter the Hot Zone, but must be escorted to a previously designated area. Those patients needing decontamination, must be escorted into the Hot Zone, triaged accordingly, and assembled in proper order according to severity of illness / injuries to await decontamination procedures.

- **Securing of patient clothing and property**

Procedures must be in place for removal and storage of patient clothing, property, and valuables. These personal items must be inventoried and labeled with each person's name. A secured holding area should be established for these patient belongings until such time as a decision is made as to their fate. It should be remembered that contaminated patient belongings could be considered evidence in an investigation of the terrorist incident and should be considered as such until law enforcement officials say otherwise.

- **Privacy**

Patients must be given as much privacy as possible during the removal of clothing and during decontamination procedures. Considerations should be made for the division of males and females during undressing and during decontamination procedures.

- **Communication**

Issues of communication between personnel operating in the triage area must be addressed. Planning must identify the areas in which personnel in the triage area must be able to communicate with each other. As well, techniques of communication must be addressed whether it be via radio communication, word of mouth, via hand signs, or written.

- **Medication and treatment supplies**

Emergency Departments must assess their need for availability of basic bandaging supplies and medications for immediate treatment of patients who have been exposed to chemical agents.

Patient Decontamination

Patient decontamination can be accomplished by one of two ways; physical removal of the agent or chemical neutralization of the agent. If a large amount of agent is present initially, a longer time is required to completely neutralize the agent to a harmless substance. Decontamination of the skin is the primary concern, but eyes and wounds must also be considered as areas in need of decontamination. The most important point to remember is that decontamination should be done as quickly as possible in attempts to lessen injury and possible death.

- **Physical Removal**

Flushing or flooding the skin with copious amounts of water or aqueous solutions is an appropriate means of removing agents from the skin. Flushing with water also dilutes chemical agents significantly enough to make them ineffective. Both fresh water and sea water have the ability to remove agents through mechanical force and also through slow hydrolysis (chemical decomposition). Physical removal of bulk agents that adhere to the skin can be removed physically by scraping the skin with a tongue depressor or by lightly scrubbing the skin surfaces with a sponge or brush during the water decontamination process.

Adsorbent material may also be used in an attempt to reduce the quantity of chemical agent available for uptake through the skin. In emergency situations, dry powders such as soap and detergents may be helpful.

The military currently uses an M291 resin kit that is carried in a wallet-like pouch and contains individual decontamination packets that contain a black powder resin that is both reactive and adsorbent.

For personal decontamination in emergency situations when water is unavailable, the use of earth or flour may also be effective decontamination tools. The use of flour followed by wiping of the skin with wet tissue paper is reported to be effective against the nerve agent Soman (GD), VX, and Mustard.

- **Chemical Neutralization**

Water and soap solutions, particularly the use of alkaline soaps, produces the effects of hydrolysis as well as physically removing the agents. Thorough washing of contaminated skin with a water and soap solution is a reasonable approach to decontamination.

A dilute (0.5%) sodium hypochlorite solution, a 1:10 solution made with 1 part household bleach and 10 parts water, is an effective skin decontaminant for patient use. A 5% sodium hypochlorite solution should be used for decontamination of equipment. This alkaline solution is advantageous in the oxidation of chemical warfare agents. However, some industrial chemicals react negatively to oxidation caused by water and/or hypochlorite solutions by producing flammable or toxic gases. In these instances, referring to the Material Safety Data Sheets (MSDS) of the known industrial chemical, consulting with the North American Emergency Response Guidebook or a poison control center, etc., is advised before decontaminating with these solutions. Once decontamination solutions are prepared they should be labeled as such, defining the type of solution, its ingredients, and whether it is to be used for patient or equipment decontamination.

- **Biological Agent Decontamination**

Since most biological warfare agents are not absorbed through the skin, with the exception of the trichothecene mycotoxins, decontamination of persons and equipment is a much lesser concern than after a chemical warfare attack. However, decontamination remains an effective way of decreasing the spread of biological organisms and their potential for spreading infection via secondary aerosolization. Decontamination procedures would only be performed if persons arrived from an immediate scene known or suspected to have had a biological agent dispersed. It does not apply to symptomatic patients who might arrive several days later following a known or suspected biological release.

In such an event, thorough washing with soap and water removes a very large amount of agent population from the skin. Mechanical loosening of the agent can be produced by lightly scrubbing the skin surfaces with a brush. Rinsing with copious amounts of water should follow.

Decontamination with a 0.5% hypochlorite solution will render the biological agent harmless because of its disinfectant properties. The solution can be applied with a cloth or swab or can be sprayed on. It should remain on the skin for 10 to 15 minutes, as time allows, before being rinsed off with copious amounts of water.

Decontamination Process

- **Patient Decontamination Process**

Once patients arrive at your facility, triage procedures should begin. Victims that have been exposed to chemical or biological warfare agents should enter directly into the Hot Zone. Those patients in need of immediate medical attention should be decontaminated first, followed by patients with delayed and minor medical needs. Decontamination of each patient should start with the removal of clothing, jewelry, etc. Porous materials such as clothing, leather wallets and belts can not be decontaminated and must be disposed of properly. Items that are nonporous, such as some items of jewelry, may be decontaminated. Ambulatory victims may be able to remove clothing themselves with little or no assistance. Non-ambulatory patients will need assistance with clothing removal. Clothing should be cut away or peeled away from the body. Careful attention should be paid to removal of clothing that is saturated with liquid chemicals so as not to expose areas of skin to further chemical contamination. With removal of the patient's clothing, the patient has been decontaminated by 80%. The decontamination process should proceed with immediate removal of any liquid chemicals on the skin. Once this has been achieved, or if no chemicals are found on the skin, decontamination of the patient should start with the head and move down the body towards the feet. As noted above, flushing with copious amounts of water, soap and water, or a 1:10 hypochlorite solution may be used. Scrubbing the skin with a sponge or soft brush may also be necessary. Thorough rinsing of the skin should follow. Depending on the amount and type of chemical exposure, whether vapor or liquid, will determine the length of the decontamination process. There have been no set standards in regards to the length of the decontamination process for chemical exposures.

- **Decontamination of Eyes**

Decontamination of the eyes is performed with copious amounts of water or normal saline. To make irrigation of the eyes easier, instilling an ophthalmic anesthetic such as Alcaine, and the use of a morgan lens, should be considered. Hypochlorite solution should never be used in eye irrigations due to its potential for causing corneal injuries.

- **Decontamination of Wounds**

During initial decontamination, bandages should be removed and wounds should be flushed with copious amounts of water. Bandages should only be replaced if bleeding recurs. Tourniquets should be replaced with clean tourniquets to areas that have already been decontaminated, 0.5 to 1 inch proximal to the original tourniquets and the original tourniquets removed, with these sites being decontaminated as well. Any splints or appliances that are in use on the patient should also be thoroughly decontaminated. Decontamination with hypochlorite solutions is contraindicated in open wounds, with brain and spinal cord injuries, and with irrigation of the abdominal cavity.

Once the decontamination process is completed, the patient will now advance into the Warm Zone. At this point, the patient will be dried off and dressed into a gown or appropriate covering. Minor wound dressing for bleeding wounds and first aid procedures may also be necessary while the patient is in the Warm Zone. After these procedures are completed, the patient may now enter into the Emergency Department for further observation and treatment.

- **Collection of Contaminated Clothing and Belongings**

Once the patient's clothing and personal belongings have been removed, they must be inventoried and contained. Each individual patient's clothing and belongings should be isolated separately, and double bagged in marked bio-hazard storage bags. A copy of the inventory checklist should then be attached to the bag. Consideration must be given to creating an isolated storage area in which to keep these contaminated items until a future decision is made as to what to do with them. It should be remembered that if the MCI incident was the result of an act of terrorism, the clothing and personal belongings may very well be considered criminal evidence. The hospital should coordinate efforts with local law enforcement and health department officials as to the fate of these patient items.

Personal Decontamination

Personal decontamination should occur at any time should you become exposed while working in the Hot Zone. This could include having any rips or tears occur in your protective suit or if for some reason your mask or protective suit is removed while working in the Hot Zone. Decontamination should also occur upon exiting the Hot zone once your duties are completed.

Personal decontamination should begin with decontamination of the protective mask, and any outer rubber gloves and boots with a 0.5% hypochlorite solution. Each of these should be thoroughly wiped down. If the protective masks have inlet valves, such as those on canister masks, the inlet valves should be covered with gauze or hands. Once these items have been decontaminated, they may be carefully removed. The protective suit is removed next by cutting or peeling and rolling the garment away from the body, careful not to expose the skin to contamination (refer to PPE doffing procedure). Personal decontamination continues in the same manner as patient decontamination.

Equipment and Facility Decontamination

As all patients and staff have been thoroughly decontaminated, equipment and the decontamination structures must also undergo decontamination prior to further use following an MCI involving chemical or biological agents. Using a 5% Sodium Hypochlorite (bleach/Chlorox) solution, decontamination of equipment and structures is obtained by simply squirting/spraying the solution with a spray bottle or by pouring the solution directly from the bottle onto the equipment. In order for effective decontamination, it should remain on the equipment for at least 5 minutes for blister/nerve agent contamination and 15 minutes for a biological agent contamination. The general procedures used by most responders is for the solution to remain on the objects for 20 minutes prior to normal cleaning. Using hypochlorite solution in this way is corrosive to most metals and injurious to most fabrics, so they should be rinsed thoroughly.

Decontamination of equipment and structures may be performed by hospital personnel without the hiring of an outside contractor. Biological agent decontamination is handled in much the same way as a blood-borne pathogen incident.

Once the decontamination process is completed, it is the responsibility of the facility/building manager to conduct testing and sampling to determine that all agent has been removed from the building. When this is accomplished, the manager can declare the building safe and completely decontaminated.

Triage Operations

The triage operation will be the foundation of your plan for treating multiple casualties resulting from an incident involving a Weapons of Mass Destruction. The word triage is derived from the French word “trier”, meaning to sort or to cull. During an actual event of this nature, triage concepts should reflect the “greatest good for the greatest number of casualties”. In the United States, most healthcare workers have had little experience with true triage decision-making. Most of us join the health care field to help other people in need. Our natural response is to try and save everyone. If all of our energy is expended in helping the first victim encountered, the greater number may suffer. The psychological impact of such disheartening decision making may be devastating to the triage workers under such high stress conditions. By using a simple system of evaluation and classification, the burden of dealing with a Mass Casualty Incident (MCI) event will be much easier.

Simple Triage & Rapid Treatment (START)

The Simple Triage & Rapid Treatment (START) system is a procedure by which large numbers of patients can be assessed quickly and accurately. Designed for use during Mass Casualty Incidents (MCI), the START system is simple to learn and requires only an understanding of basic first-aid to apply. Originally developed for use in pre-hospital triage by EMS or emergency response personnel, the START system is applicable for use in hospital emergency departments. Many jurisdictions across the United States have adopted the START system because of its simplicity.

Principles Of The START System

A Mass Casualty Incident (MCI) can generally be defined as; any sudden emergency situation, event or accident which has produced, is believed to have produced, or may produce, a minimum of five (5) patients.

Statistics indicate that most trauma patients die within the first hour after sustaining their injuries. These deaths are commonly the result of respiratory complications, Central Nervous System (CNS) trauma, or exsanguination. For the patient who has sustained trauma injuries, this first hour is so critical it has been referred to as “The Golden Hour”. The START system allows EMS and other emergency response personnel to triage patients at the site of a Mass Casualty Incident in 60 seconds or less, per patient. Patients are evaluated and placed into one of four (4) treatment classifications:

- **Minor** ‘walking wounded’ (Green tag)
- **Delayed** ‘minor abnormal findings’ (Yellow tag)
- **Immediate** ‘abnormal findings’ (Red tag)
- **Deceased** (Black tag)

This system of assessment is based on three (3) primary observations:

- Respiratory status.
- Perfusion and pulse.
- Neurological status.

* Remember the pneumonic **RPM** (**R**espirations, **P**erfusion, **M**ental Status)

The START system calls for emergency response personnel to identify and address the main threats to life: blocked airways and severe arterial bleeding. The START system also utilizes the METTAG Triage Card, which classifies patients into the four (4) treatment areas.

How START Works

The triage team must evaluate and place the patients into one of four categories.

Minor (Green Tag)

- All victims who are able to walk on their own (“walking wounded”) are separated from the general group during the beginning of the triage operation by asking “those of you that can walk, please do so and move to this area”.
- These patients are directed to a safe location away from the scene where they are tagged ‘green’ for minor injuries. Further triage and treatment of injuries can now be done.
- These patients will require supervision and might be detained for ongoing assessment or decontamination.
- These patients can also be utilized to assist with the control of bleeding and airway maintenance of patients tagged ‘Red’ for immediate care.

Delayed (Yellow Tag)

- Any patient that does not have a compromising injury but is unable to ambulate due to the injury.
- All victims who do not fit into either the Minor or Immediate categories, or who otherwise exhibit normal findings or minor abnormal findings will be tagged ‘Yellow’ for delayed.
- These patients may also assist with the care of Red Tagged ‘immediate’ patients.

Immediate (Red Tag)

- Patients that have respirations present only after repositioning of the airway or those patients that have greater than 30 respiration per minute.
- Patients who have delayed capillary refill (greater than two seconds).
- Patients who are disoriented or unable to follow simple commands.

Deceased (Black Tag)

- Any victim with no spontaneous respiratory function, even after attempting to reposition the airway will be tagged ‘Black’ for deceased.

Assessment Procedures

- **Respiratory**

Assess patient for ventilatory adequacy and rate.

If the patient is breathing more than 30 times per minute, **Tag The Patient RED** and move on to the next patient.

Patients who have adequate respirations, less than 30 per minute, are **Not Tagged At This Time. Assess These Patients For Perfusion.**

If the patient is not breathing, check for foreign objects causing obstruction in the mouth. Remove loose dentures. Reposition the head, using cervical spine precautions only if this does not delay assessment. If the patient's respirations spontaneously return, make sure the airway is secure. If respirations are greater than 30 times per minute, **Tag The Patient RED** and move on to the next patient. (Here is where the "walking wounded" can assist). If respirations are adequate and at a rate less than 30 times per minute, do **Not Tag At This Time**, continue with assessment of perfusion.

If the above procedures do not initiate respiratory efforts, **Tag The Patient BLACK** and move on to the next patient.

* The treatment and stabilization of possible spinal injuries in multiple or mass casualty incidents is different than what you may have previously been taught. Due to time constraints with such a large number of victims, there may not be enough time to properly stabilize every injured patient's spine.

- **Perfusion**

The best method to assess perfusion is by assessment of capillary refill. Press nailbeds or lips and release. Color should return to these areas within two seconds.

If there is a delay greater than two seconds for color to return to these areas, the patient is showing signs of inadequate perfusion, **Tag The Patient RED.**

If capillary refill can not be assessed, palpate the radial pulse. In most cases, if the radial pulse cannot be felt, the systolic blood pressure will be below 80 mmHg. Control significant bleeding by direct pressure and elevate the lower extremities. Utilize the "walking wounded" to assist with hemorrhage control of these patients. **Tag The Patient RED.**

If color returns to nailbeds or lips within two seconds, or the patient has a palpable radial pulse, the patient is **Not To Be Tagged At This Time. Assess These Patients For Mental Status.**

- **Mental Status**

The mental status evaluation is used for patients whose respirations and perfusion are adequate. To test mental status, the rescuer should ask questions to determine orientation. "What is your name?". "What city are you in?". "What year is it?". The rescuer should also ask the patient to follow simple commands such

as “open and close your eyes” or “squeeze my hands”.

If the patient can not answer questions appropriately or cannot follow simple commands, **Tag The Patient RED.**

If the patient is alert, oriented, and can follow simple commands, **Tag The Patient YELLOW.**

Only after all patients have been triaged can patients be treated. The above procedure should take no more than 60 seconds per patient.

Triage Tags

Patients who arrive in the Emergency Department after they have been triaged by rescue workers at the scene, should arrive with a triage tag attached to their body. These tags should relay information such as:

- Triage date and time
- Name of patient, if available
- Address of patient, if available and time allows
- Other medical information such as medical history, medications, etc., if available and time allows
- Injuries should be noted on the diagram
- Treatment procedures, IV's, medications given should be listed

This information provided should assist the hospital personnel during their triage procedures, but should not be totally relied upon due to possible deterioration in patient's condition during transport.

It has also been noted that slight variations occur in the START triage procedure from region to region. We advise that you communicate with your local EMS system to determine their exact guidelines used in Mass Casualty Incidents.

Personal Protection Equipment (PPE)

As medical personnel working with patients on a daily basis, we are all familiar with Universal Precautions. These precautions are taken to protect healthcare providers from possible contamination by blood or body fluids. The same precautions needed holds true when exposure to a chemical or biological agent is possible. The only difference is in the types and levels of equipment necessary. The following text will explore the various equipment needed and explain the Levels of PPE necessary to keep exposure of the respiratory system and skin surfaces to a minimum when confronted with patients contaminated with a chemical or biological agent.

Respiratory equipment

There are two major categories of respirators:

- Air-purifying respirators
- Atmosphere-supplying respirators

Air-purifying Respirators

Air-purifying respirators have filters, canisters, or cartridges that remove contaminants from the air as the air passes through the air-purifying filters when the user breathes. There are four types of air-purifying respirators available:

- Particulate Respirators
- Gas and Vapor Respirators
- Combination Respirators
- Powered air purifying respirators (PAPR)

Particulate respirators capture particles such as dusts, mists, and fumes from the air. They do not protect against gases and vapors. Filters should be replaced when the user finds it difficult to breath through them.

Gas and vapor respirators use chemical filters (called cartridges or canisters) to remove dangerous gases from the air and are used when there are only hazardous gases and vapors present. There are a wide range of filters available for specific gases or vapors. Protection is provided only as long as the filter's absorbing capacity is not compromised. These respirators do not protect against airborne particles.

Combination respirators have particulate filters and gas/vapor filters and are used when the atmosphere contains both types of hazards. This type of respirator may be heavier than other model types.

The powered air purifying respirator (PAPR) provides a continuous flow of air filtered through cartridges. This unit is belt-mounted for comfort and is powered by a rechargeable nicad or disposable lithium battery, which may give up to 8 hours of service time. Interchangeable cartridges are available for specific needs.

Atmosphere-supplying Respirators

Atmosphere-supplying respirators supply clean air directly to the user from a source other than the air surrounding the user. There are three different types of atmosphere-supplying respirators available:

- Supplied-air respirators (SAR)
- Self-contained breathing apparatus (SCBA)
- Combination respirators

Supplied-air respirators (SAR), also called airline respirators, consist of a hose to deliver clean, safe air from a stationary source of compressed air. An SAR may be used for long periods of time and are light weight for the user to carry. Depending on the cord length, mobility may be limited and may fail due to hose damage. These respirators are normally used in atmospheres that **are not** immediately dangerous to life and health (IDLH).

A self-contained breathing apparatus consists of a wearable, clean-air supply pack. This respirator does not restrict movement. Closed-circuit types can provide up to 4 hours of air supply, where as the open-circuit type only provides air for 30 to 60 minutes. These respirators are normally used in atmospheres which **are or may be** immediately dangerous to life and health (IDLH).

Combination respirators have an auxiliary self-contained air supply that can be used if the primary supply fails. The self-contained portion can be small, only supplying enough air for the user to escape. These respirators are normally used in atmospheres that **are or may be** immediately dangerous to life and health (IDLH).

Types of Masks

- Partial face
- Full face
- Hoods

Partial face masks protect the respiratory system only. There is no protection for the facial skin or eyes. Protective eye wear may be worn with this type of mask.

Full face masks protect the respiratory system, facial skin, and eyes. These types of masks are generally seen with atmosphere-supplying respirators.

Hoods are also available to protect the respiratory system, facial skin, and eyes from contamination. These types may also be seen with atmosphere-supplying respirators.

Inspection of the Respirator

Before and **after** each use of your respirator, you must inspect it for signs of wear. You should look for:

- Any cracks or chips in the face plate
- Cracks or holes in the breathing tube or airline

- Worn, broken, or frayed straps
- Worn or damaged fittings
- Bent or corroded buckles
- Dirty or improperly seated valves

If at any time you find something wrong with your respirator, **do not** use it. It must be repaired or replaced immediately.

Storing Respirators

If your respirator is not going to be used immediately, it must be stored in a sealable plastic bag somewhere that is convenient for you, but is away from:

- Dust
- Sunlight
- Heat
- Extreme cold
- Moisture
- Damaging chemicals

Donning the Respirator

- Hold the respirator to your face with one hand.
- While holding the respirator in place, slip the head straps of the harness over your head.
- Adjust and tighten the head harness straps until the respirator fits snugly to your face. The easiest way to tighten a respirator is by tightening the straps from the bottom up.

✓**Note:** Contacts can not be worn with full face respirators.

Fit Testing the Respirator

Each time you wear the respirator, it is important to do fit testing, both positive and negative pressure testing, to ensure an airtight seal between your face and the respirator. The purpose of ensuring an airtight seal is to prevent contaminants from getting inside the facepiece and into your lungs.

Positive pressure testing is done by closing the respirator's exhalation valve by covering it with your hand and breathing out slowly. The facepiece will bulge out slightly. Hold your breath for about 10 seconds. If no air leaks out around the facepiece during this time, you know you have a good positive pressure fit. If however, air does leak out, you do not have a proper fit. You must then readjust the head harness straps, and repeat the positive pressure test again until a proper seal is ensured.

Negative pressure testing is done by closing the respirator's inhalation valves with your hands and breathing in slowly. The facepiece will collapse slightly. Hold your breath for about 10 seconds. If no air leaks in from around the facepiece during this time, you know you have a good negative pressure fit. If however, air does leak in, you do not have a proper fit. You must then readjust the head harness straps, and repeat

pressure testing again until a proper seal is ensured with both positive and negative testing.

Protective Clothing

- Overgarments
- Gloves
- Foot coverings

Overgarments are to be worn to protect skin from chemical or biological agents. These overgarments can be made of fabric that is impermeable to most molecules, even to air and water vapor. A wide range of overgarments exist and each have varying protective levels.

Some overgarments are made to be decontaminated and used again, while others are made for one time use only and are then disposed of. Because of the impermeable features of some suits, hyperthermia and dehydration may easily occur.

Gloves cover and protect hands from chemical or biological agents. These gloves are usually made of vinyl or neoprene and are worn over an inner pair of gloves. Because of the thickness of these gloves, they may be cumbersome making tedious processes difficult.

Foot coverings may be included in the overgarment or may be separate, such as boots.

Environmental Protection Agency (EPA) Levels of Protection

EPA guidelines define four distinct levels of protection - A, B, C, and D - when working with hazardous or suspected hazardous materials. Level A provides the highest level of protection, where as Level D provides the lowest level.

Level A

Level A protection is required for work in oxygen deficient environments and/or when there is potential exposure to known, unknown, or suspected, hazardous materials that are or may be immediately dangerous to life and health (IDLH). Level A provides the highest level of skin, respiratory, and eye protection available. Level A equipment would be required for rescue workers at the site of a chemical or biological incident. Level A equipment includes:

- positive-pressure, full-facepiece self-contained breathing apparatus (SCBA) or positive-pressure supplied air respirator with escape SCBA approved by the National Institute for Occupational Safety and Health (NIOSH)
- fully encapsulating chemical protective suit
- outer chemical-resistant gloves
- inner chemical-resistant gloves
- chemical resistant footwear, boots
- disposable protective suit, gloves and boots (depending on suit construction, may be worn over totally-encapsulating suit)

Level B

Level B protection is necessary when the highest level of respiratory protection is necessary but a lesser level of skin protection is needed. Level B does not require a totally vapor-protective suit as necessary with Level A protection. Level B provides liquid splash protection. Level B equipment includes:

- positive-pressure, full-facepiece SCBA or positive-pressure supplied air respirator with escape SCBA approved by National Institute for Occupational Safety and Health (NIOSH)
- hooded, chemical-resistant clothing (overalls and long-sleeved jacket; coveralls; one or two-piece chemical-splash suit; disposable chemical-resistant overalls)
- outer chemical-resistant gloves
- inner chemical-resistant gloves
- chemical resistant footwear, boots

Level C

Level C protection is necessary under circumstances that require lesser levels of respiratory and skin protection. Level C equipment requires less respiratory protection than Level B. Properly selected air-purifying respirators are used in Level C equipment when the atmosphere is Non-IDLH and the concentration of oxygen is greater than 19.5% and when the types of airborne contaminants have been identified and canisters or filters are available to remove these contaminants. Level C equipment includes:

- full-face or half-mask, air purifying respirators approved by NIOSH
- hooded, chemical-resistant clothing (overalls; two-piece chemical-splash suit; disposable chemical-resistant overalls)
- outer chemical-resistant gloves
- inner chemical-resistant gloves
- chemical-resistant footwear, boots

Level D

Level D provides minimal skin protection and no respiratory protection. Level D generally means a work uniform and is the minimum protection required when working with chemicals. With Level D protection, the atmosphere must not contain a known, or suspected, hazard. Level D equipment includes:

- coveralls
- chemical-resistant footwear, boots
- safety glasses or chemical splash goggles
- gloves (optional)
- face shield (optional)

Emergency Department Equipment

Emergency Department personnel who may be responding to incidents involving chemical or biological releases, must have appropriate equipment to keep them safe. Since Emergency Departments will be receiving victims from an off-site scene, unless the site of release is at the hospital itself, Level B or a combination of Level B and Level C is required.

Respiratory protection must afford the user the ability to breathe without contamination from chemicals or biological agents. This may be accomplished with the use of a powered air purifying respirator (PAPR) that is easily carried on the person's body. All skin surfaces must be covered with chemically-resistant clothing to prevent possible exposure. Chemically-resistant gloves and shoe covers/boots must also be worn.

The Buddy System

Donning of PPE can be very difficult by oneself. Monitoring your own suit for rips or tears during the performance phase of an operation can also be very difficult. This is why a Buddy System should always be in place. The buddy system is a procedure by which 2 personnel are identified by each other prior to donning of equipment and the entering of a hazardous area. Each person is responsible for assisting the other person into their PPE while examining for faulty equipment, improper fitting of equipment, rips or tears in protective clothing, etc. Responsibilities continue while in a hazardous area to ensure that each person's equipment continues to work properly and that there have been no compromises to the buddy's PPE.

Proper Donning of PPE

Standard operating procedures should be established for the donning of PPE. A routine should also be established and practiced periodically to ensure that all members of the Emergency Department staff are familiar with such procedures.

Donning Procedure

- Identify your buddy
- Collect all equipment needed
- Inspect protective clothing and respiratory equipment
- Step into coveralls and zip closed (Zipper should be in the front)
- For coveralls with foot coverings, ensure that feet are properly seated into foot coverings
- Your buddy or assistant should pull up on coveralls above the ankle level and should tape snugly, using duct tape, above the ankles to prevent tripping should your feet come out of the foot coverings
- Outer boots may be worn and your buddy or assistant should seal the entrance to the boots by using duct tape to tape around the top of the boots
- The midline seam of the coverall should be strengthened by sealing it with duct tape. Your buddy

or assistant should start taping the midline seam at the nape of the neck. The tape should be completely covering the seam and adequately secured down the back. You should then squat and bring the tape between your legs, ensuring that the seam is covered. Your buddy or assistant should continue taping upward, covering the zipper, until the throat area is reached. (Squatting during this procedure ensures that you have room to move in your suit when bending over, squatting, etc.)

- If your respiratory equipment includes a full-faced mask, apply the respirator and fit battery pack around waist or on back as applicable. Test battery for performance. Perform positive and negative pressure tests to ensure proper fitting. Place hood of coveralls on head and over outer edges of the respirator. Your buddy or assistant should securely tape around the edges of the suit's hood to seal the entrance of the hood to the respirator face mask.
- If your respiratory equipment includes a hooded type respirator, place coverall hood on your head. Fit the respirator's battery pack around waist or on back as applicable and place hood of respirator over your head. Test battery for performance. Your buddy or assistant should ensure that all layers of the hood are properly distributed.
- Put on inner gloves and tuck into sleeves of coveralls. Your buddy or assistant should tape end of the sleeves to the gloves, using duct tape, to seal sleeve's entrance.
- Put on outer gloves and your buddy or assistant should tape the end of the gloves to the coverall, using duct tape, to ensure the seal of the glove's entrance.
- Once again, your buddy or assistant should observe your ensemble for any compromise in the integrity of your PPE or for any protective clothing that is ill fitting. (If clothing is too small, it will restrict movement and increase the chances of tearing the suit material. If the clothing is too large, the possibility of snagging the material is increased, and the dexterity and coordination of the wearer may be compromised.)

Monitoring Your Protective Clothing and Respirator

Respirators must be monitored for a continued seal around your face, but you must also monitor how well your respirator is working. You should never use or continue to use a respirator that is not functioning properly. You will know your respirator is not working when:

- You can smell or taste the contaminant
- Breathing becomes difficult
- You become dizzy or sick feeling
- The manufacturer's recommended service life of the filters or cartridges expires
- The respirator becomes damaged

While you are working in a hazardous area, you must continually monitor your own protective ensemble, your buddy's ensemble and other personnel's ensembles as well. With any notice of a compromise in your suit or another worker's suit, the person should be notified of the compromise, decontaminated immediately, and moved out of the hazardous area. Once out of the hazardous area, the worker should be examined thoroughly for any signs or symptoms of physical contamination.

Proper Doffing of PPE

Standard operating procedures for doffing of PPE should be established as well. A routine should also be established and practiced periodically to ensure that all members of the Emergency Department are familiar with such procedures.

Doffing Procedure

- Notify the incident supervisor and your buddy that you are leaving the hazardous area.
- Step into Decon area for removal of ensemble.
- Assistant should wash outer boots, gloves, and respirator (excluding any canisters or cartridges) with 5% Hypochlorite solution.
- Assistant should remove duct tape from around gloves and boots and assist with their removal.
- Assistant should then remove all duct tape from around suit.
- If your respiratory equipment includes a full-faced mask, assistant should begin with the suit's hood and roll it off the head so that it is inside out.
- If your respiratory equipment includes a hooded face mask, assistant should dip scissors in 5% Hypochlorite solution and cut suit around neck area which will leave hood of suit to remain under respirator hood.
- The suit should then be unzipped and the assistant should roll the suit inside out starting at the rear shoulders. As the suit is being rolled down, you would pull your arms out the sleeves, leaving the suit sleeves inside out. Once the suit has been rolled inside out down the legs, you would then step out of the suit.
- Assistant should then remove your inner set of gloves by rolling them inside out as they are removed from your hands.
- Assistant should now assist you with removal of your respirator.
- You should then completely undress and shower with appropriate deconning solution (soap and water or 0.5% Hypochlorite solution).
- All disposable gloves, suits, and respirator canisters or cartridges should be discarded appropriately.
- All non-disposable equipment should be decontaminated with a 5% Hypochlorite solution.

Determining Equipment Needs

As Biological and Chemical incident response plans are formulated, so should the equipment needs list. Depending upon the number of incident responders and the standards that are set for time spent in the hazardous area, enough equipment should be available for protection of all workers. Areas that should be identified are as followed:

- Enough protective suits, gloves, and boots should be available to properly fit all medical and other responders as each individual rotates through the hazardous area. For example: If your determined standards are that no individual will remain in the hazardous area for more than 4 hours, then equipment must be available for each worker's rotation based upon a predetermined operation time standard, such as 12 or 24 hours. You must also take into account the possibility that some workers may have to leave the hazardous area prior to the 4 hour standard of time.
- When determining the amount of respirators needed, you must take into account the number of individuals working in the hazardous area at one time, as well as reserve respirators, reserve battery packs, and reserve canisters/cartridges that will be needed for future workers relieving those presently in the hazardous area and continue to relieve those workers over a predetermined operation time standard, such as 12 or 24 hours.

Critical Incident Stress

Critical incident stress, also known as post-traumatic stress, is a syndrome which can occur when someone has been involved in, or has witnessed a traumatic event. Events which can cause a critical incident stress condition are many and include: natural disasters, violent accidents, acts of terrorism, community violence, workplace violence, military combat, etc. Events such as these can have an adverse effect on the psychological, physical, emotional and spiritual health of the people involved. This type of stress can have a negative effect on a person's sense of trust and security, personal belief systems, personal and family relationships, work relationships, work performance, etc. Symptoms of critical incident stress can occur during the incident, shortly after the incident or years later. Untreated, the problems created by critical incident stress could last years or possibly decades. The following symptoms have been associated with individuals suffering from critical incident stress:

- Recurrent disturbing memories of the incident, mentally re-experiencing the incident.
- Intense psychological distress when exposed to reminders of the incident.
- Difficulties with sleep patterns, problems falling or staying asleep, experiencing recurrent nightmares about the incident.
- Avoiding activities or situations which trigger memories of the incident.
- Becoming socially isolated, feelings of detachment, diminished interest in personal or family relationships, lack of interest in activities which were once important.
- Problems with controlling anger or aggression.
- Difficulty with mental concentration or staying focused.
- Feelings of depression.
- Obsessive thoughts relating to the incident.
- Developing addictions to drugs or alcohol.
- Experiencing personal feeling of guilt over the incident.
- Experiencing feeling of hyper-vigilance after the incident.

Emergency response personnel such as police officers, EMS personnel, firefighters, etc. are all susceptible to the stress created by the incidents they respond to on a daily basis, sometimes more so than the people involved, due to the number of such incidents one might respond to over a career. Medical personnel working in the emergency department are also no strangers to stress. Providing care and treatment for patients with any number of life threatening injuries or illnesses can also take its toll on these workers as well. However, the stress which may be encountered during a mass casualty incident involving the use of a Weapon of Mass Destruction may be significantly greater than what we have been exposed to in the past.

Emergency Department Staff Support

Weapons of Mass Destruction are designed to create very high numbers of casualties, so one should assume that the terrorist use of such a weapon would result in large numbers of people seeking medical treatment. In an incident such as this, it's possible that the Emergency Department personnel may be responsible for the triage and decontamination of hundreds of patients, be confronted with large numbers of fatalities, face a prolonged operational deployment, and conduct the majority of the operation while wearing Level A or B protective clothing. The thoughts of this alone are stressful enough. Being on the front lines of incoming casualties, having to make critical triage decisions which may affect lives, being in a claustrophobic environment inside your PPE, having possible feelings of isolation, physical fatigue, dehydration, etc. These are all stressors that Emergency Department staff may encounter during a disaster. Because of these stressors, a program should be in place to meet each staff member as they return from working in the hazardous area. Vital signs should be obtained. Food and drink should be given. The person should be given the chance to express his or her feelings about the event. A rest period should ensue. And prior to returning to the hazardous area, the person must be evaluated for their mental and physical capabilities to return to such a stressful environment. Stress debriefing and evaluation must also continue once the event is over. No one will know how they will react under such stressful conditions until the time comes. Proper planning, coordination, and practice drills will afford the Emergency Department staff a chance to prepare for some of these stressors.

The Emergency Department should consider critical incident stress a very real factor in its operational planning, and develop contingencies for handling stress related problems which could effect its staff. The following are some basic points to consider:

- Emergency Department personnel and their management should acquire and study information related to critical incident stress. Organizations specializing in critical incident stress and post traumatic stress have been included in the information resources section of this manual.
- Contact the hospital's Social Services department and inquire about stress related programs and information available to the staff.
- Emergency Department staff should consider attending training programs or seminars dealing with critical incident stress.
- Consideration should be given to developing a peer counseling program in stress management.
- Develop a procedure for post incident staff debriefings.
- Develop a procedure which will allow staff members to monitor each other for stress related symptoms during periods of operational deployment. This concept should take the form of a "buddy system" or other partner related procedure.

Victim and Family Support

Healthcare providers must be prepared to deal with not only the physical aspects, but also the emotional aspects of a disaster. Victims, family members, and even co-workers may exhibit a wide range of emotions. These emotions can be of sadness, desperation, isolation, anger, fear, etc. and can manifest themselves in

many ways, such as uncontrollable outbursts, violent behavior, psychotic episodes, etc. Healthcare providers must recognize that these emotions are not directed at them, but at the uncontrollable result of the disaster itself. Therefore, disaster planning should involve clergy, social workers, mental health evaluators, psychologists, psychiatrists, etc., to assist healthcare providers in treating the emotional aspects that come with a disaster. Stress debriefing sessions, finding family members, help with immediate planning, assisting with food and shelter if it should be necessary, are all areas in which these resources can be used to help alleviate the immediate emotional burden.

Healthcare Personnel Support

All other hospital personnel participating in the MCI response should also be given the same attention as victims and family members. Critical incident stress debriefing will be essential and should be made available early in the course of the disaster. Stress debriefings will give hospital personnel a chance to vent their feelings and provide a mechanism to identify individuals in need of further counseling. Disaster planning should include exact measures to be taken to provide this debriefing for healthcare workers.

News Media Relations

The first step in developing an effective relationship with members of the news media is understanding the function of the press. Simply put, the press has the job of reporting the news to the public. Today the news is a 24 hour a day, globally reaching business that encompasses television, radio, newspapers and magazines. National and International news agencies, their reporters and cameramen are constantly searching for stories that may interest and inform the general public. From the city streets in the United States to a battle field abroad, the members of the press often times risk their own lives to report these stories. In addition, with the advances in technology, news reporting has become nearly instantaneous, allowing the general public to watch these stories as they unfold. The combination of dedicated news professionals and advanced news reporting technologies can nearly guarantee an important news story is never out of reach of the camera's eye.

Incidents involving violence, crime or terrorism are usually considered important news stories and generally end up as headlines in all forms of the press. It should be easy to assume that a terrorist incident involving the use of a Weapon of Mass Destruction would fall into the category of headline news. If such a terrorist incident were to occur, you can be assured that considerable news media resources would be mobilized to cover the story. It should also be easy to assume that news agencies would attempt to report such a story in as extensive detail as possible. This detailed coverage of the event could include; live reporting from the scene of the incident, live reporting from hospitals providing medical treatment for event casualties, interviews with Government officials, Law Enforcement, Fire Department and EMS officials, Medical personnel providing treatment, incident victims and their families, etc. With this reality in mind, it is necessary to conduct advance planning in the area of news media relations in order to be prepared to effectively handle such an event.

Both the Hospital and Emergency Department should have established policies and procedures for handling a news media event. These policies and procedures should be implemented to insure that key areas of importance, such as personnel safety, operational security, patient information confidentiality, and accurate information dissemination are addressed. The following are key points to consider when developing policies and procedures for handling news media events:

- Policies and procedures regarding the news media should be developed to insure proper handling of press matters during an event, as well as non-event times.
- All policies regarding the dissemination of information to the press should be in writing.
- The Hospital Administration should develop policies and procedures for granting interviews, as well as issuing press releases to news agency personnel.
- During an actual incident, hospital staff members should refrain from granting press interviews. Because the hospital staff will most likely be busy with the task at hand, unnecessary distractions should be kept to a minimum. Request for information by media personnel should be referred to the hospital Public Information Officer or the Information Officer operating through the Incident Command System (ICS). This should insure the continuity of information dissemination throughout the event.

- Consideration should be given to creating policies and procedures for handling requests and/or attempts by news media personnel to gain access to patient treatment areas, triage and decontamination areas, or other areas in which the hospital staff is operating.
- Fact sheets regarding the characteristics of chemical and biological agents, routine decontamination procedures, agent transmission data, treatment protocols, etc. should be prepared in advance and given to media personnel. This will allow journalists to have current and reliable information in which to disseminate to the public.
- Staging areas for news media crews must be established in advance. Consideration should be given to insuring that press personnel have the space necessary to operate without interfering with medical operations. Access to electricity and telephones should be made available to news media personnel, within reason.
- If the Hospital Administration grants the requests for interviews by media personnel, these interviews should take place in an area away from the confusion of on-going operations.
- When granting interviews with media personnel, hospital staff should only speak with accredited officials of the press.
- It should be remembered that press officials are not granted any special authority or rights to enter on private property, remain on private property or force persons to make statements. If press officials have entered into an area where their presence is not authorized, simply refer them to the Public Information Officer and ask them to leave. If they do not honor the request, notify your Security team or local Law Enforcement for assistance.
- Members of the Hospital staff should refrain from engaging in any altercations with press personnel. Never threaten, push or strike a member of the press. Never place your hand over the lens of a news camera, grab a news camera, etc.. If you do not want to make a statement at that time, simply don't.

Information Resources

The following is a list of information resources available on the World Wide Web. This list represents some of the best sources of information relating to terrorism and Weapons of Mass Destruction from the U.S. Government, U.S. Military, Corporate sector, and organizations located outside the U.S. It should be noted that this list is only a partial representation of the information currently available on the World Wide Web. We encourage you to investigate the link sections of these sites to discover new resources. All of the web site addresses listed here were verified as operational at the time of this printing.

NOTE:

- Protective Research Group, Inc. has compiled and presented this resource list as an educational tool and does not except responsibility for the information content of any of the web sites listed.

Nuclear / Biological / Chemical / WMD Information

Chemical and Biological Defense Command www.cbdcom.apgea.army.mil

Chemical and Biological Defense Information Analysis Center www.cbiac.apgea.army.mil

U.S. Army Soldier and Biological / Chemical Command www.sbccom.apgea.army.mil

Chemical Transportation Emergency Center www.cwc-chemical.com/chemtrec.htm

Chemical and Biological Arms Control Institute www.cbaci.org

Chem-Bio Resource Center www.chem-bio.com/resource

Nuclear Control Institute www.nci.org

Chemical and Biological Weapons Non-proliferation Project www.stimson.org

U.S. Army Medical Research Institute of Chemical Defense www.chemdef.apgea.army.mil

Federation of American Scientists www.fas.org/bwc/bwcweb

Chemical and Biological Warfare Project www.sipri.se

Nuclear Weapons Convention www.igc.apc.org

Organization for the Prohibition of Chemical Weapons www.opcw.nl

Public Safety Group www.psgcabo.com

Federal Bureau of Investigation www.fbi.gov

Occupational Safety and Health Administration www.osha.gov

Environmental Protection Agency www.epa.gov

U.S. Department of Health and Human Services www.dhhs.gov

DHHS Office of Emergency Preparedness www.oep.dhhs.gov

Centers for Disease Control Biological Terrorism Section www.bt.cdc.gov

Medical Information And Organizations

Association for Professionals in Infection Control and Epidemiology www.apic.org

Centers for Disease Control www.cdc.gov

NBC Medical Web Server www.nbc-med.org

Disease Outbreak Network www.outbreak.org

International Physicians for the Prevention of Nuclear War www.healthnet.org/IPPNW

American College of Emergency Physicians www.acep.org

Emergency International www.emgint.org

International Critical Incident Stress Foundation, Inc. www.icisf.org

The American Academy of Experts in Traumatic Stress www.aaets.org

The National Center For PTSD www.dartmouth.edu/dms/ptsd

The International Society for Traumatic Stress Studies www.istss.org

Pharmaceutical Information Network www.pharminfo.com

National Institutes of Health www.nih.gov

National Institute for Occupational Safety and Health www.niosh.gov

Equipment Manufacturers, Suppliers, and Training Resources

DuPont Protective Apparel Home Page
www.dupont.com/corp/markets/apparel/protective/phome.htm

GEOMET Technologies, Inc. www.nbcprotect.com

QuickMask, Inc. www.quickmask.com

Gas Masks Inc. www.gas-mask.com

Modec - Mass Casualty Response Systems www.massdecon.com

Disaster Management Systems www.disastermngt.com

Kappler Pro Apparel www.kappler.com

Tyvek Protective Clothing www.protectivesuits.com

Shalon Chemical Industries www.doryanet.co.il/shalon/1.htm

Mine Safety Appliances www.msanet.com

Chemfab Corporation www.chemfab.com/index.htm

Lab Safety Supply www.labsafety.com

Environmental Resource Center www.ercweb.com

Rothstein Catalog on Disaster Recovery www.rothstein.com/catalog.html

Affordable Instant Shelters www.instantshelters.com

Safety Source Online www.safetysource.com

References

Medical Management of Chemical Casualties Handbook
Medical Research Institute of Chemical Defense, Sept. 1995

Medical Management of Chemical Casualties Handbook
Medical Research Institute of Chemical Defense, Aug. 1999

Medical Management of Biological Casualties Handbook
U.S. Army Medical Research Institute of Infectious Diseases, Aug. 1996

Medical Management of Biological Casualties Handbook
U.S. Army Medical Research Institute of Infectious Diseases, Sept 1999

Taber's Cyclopedic Medical Dictionary
F.A. Davis Company

North American Emergency Response Guidebook
U.S. Department of Transportation

About the Authors

Wade M. Knapp, CPS

Mr. Knapp is President of Protective Research Group. He is a Certified Protection Specialist with over 22 years experience in the protection industry, including 11 years in security management. He is a graduate of Executive Security International, Aspen CO., and has obtained education in Law Enforcement, Security Management, Executive Protection, Biological & Chemical Terrorism, Disaster Management, Basic Life Support (BLS), Advanced Hazmat Life Support (AHLS), and Self-Defense. In addition to his career in Security Management, he is also an experienced Bodyguard, Licensed Security Instructor, Basic Life Support Instructor, Workplace Safety Instructor, Safety & Security Lecturer, Safety & Security Author, a former Private Investigator, and a 1st Degree Black Belt and Self-Defense Instructor. He is a member of the International Association of Counter-Terrorism & Security Professionals, Terrorism Response Association, Association of Contingency Planners, Disaster Preparedness and Emergency Response Association, American Federation of Police and Concerned Citizens.

Lee A. Knapp, RN, CEN

Mrs. Knapp is Vice-President of Protective Research Group. She is a Registered Nurse and Certified Emergency Nurse with over 17 years experience in the medical industry, including over 15 years in the field of emergency nursing. Mrs. Knapp is a graduate of Marshall University School of Nursing, and has an extensive background in the field of emergency medicine. Certifications and education include: Nursing Management, Basic Life Support (BLS), Advanced Cardiac Life Support (ACLS), Pediatric Advance Life Support (PALS), Advanced Hazmat Life Support (AHLS), Biological & Chemical Terrorism, and NBC Terrorism medical response. In addition, she is an experienced Medical & Safety Lecturer, Basic Life Support Instructor, Advanced Hazmat Life Support Instructor, Workplace Safety Instructor, and Terrorism training coordinator for the Emergency Department at St. Vincent's Medical Center in Jacksonville, Florida. She is a member of the Terrorism Response Association, Association of Contingency Planners, Disaster Preparedness and Emergency Response Association